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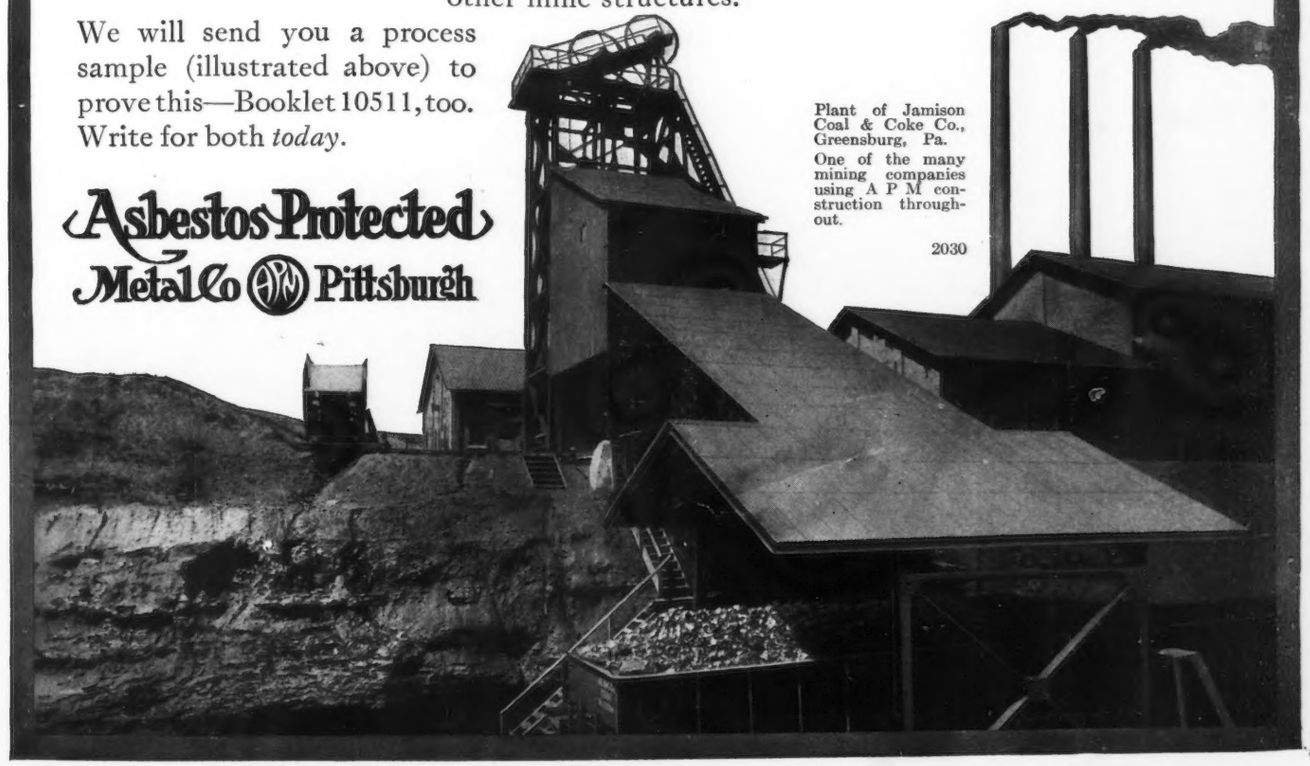

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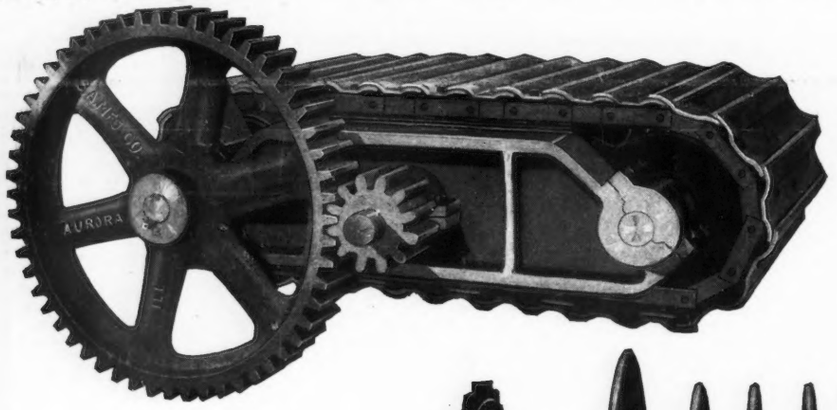

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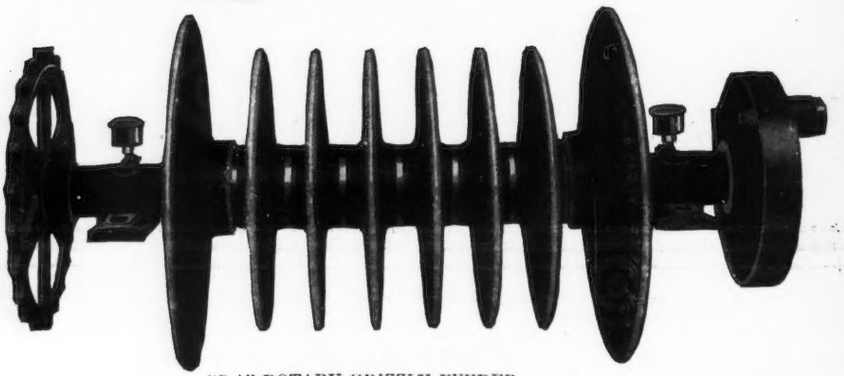

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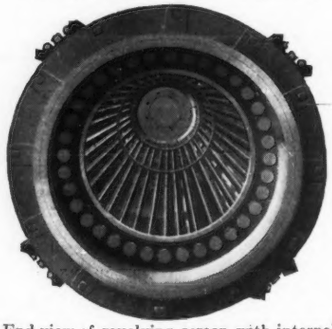

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The Engineering and Mining Journal

VOLUME 101 JUNE 24, 1916 NUMBER 26

Drill- and Tool-Sharpening Shop at the Copper Queen Mine

"G. S."

SYNOPSIS—Central shop for the sharpening of drill and tool steel designed as a result of extended time study and efficiency work. Central shops supply drills for four different shafts situated 2,600 to 3,800 ft. apart. Shop handles and sharpens over 1,200 pieces of steel and tools per day. Detailed cost of sharpening given for different items of expense. Cost of making up new steel and time required for each and the number of sharpeners and helpers engaged. Interesting application of a mirror to a drill sharpener to enable the operator to see the bit which he is forming, which ordinarily is obscured by the construction of the machine.

The productive area of the Warren district, Arizona, is wide and comparatively shallow. Many shafts are therefore needed, for convenient access to working places. At the Copper Queen six are now in operation. In 1908, when ore hoisting was centralized, the blacksmith shops at each shaft were abandoned in favor of the large and more convenient quarters which formed a part of the central shops then newly built. Drills and tools were still sharpened at the different shafts. A Holbrook power sharpener was operated on two shifts, the other sharpeners only on one. Frequently there were enough picks, tools etc., to keep a man or two for hand work on night shift as well as day.

The only advantage of several local shops close to the work is that transportation on the surface is not required. The objections to that arrangement arise from the number of shops in operation. In every shop there must be enough workmen to carry the peak load, but upon an ordinary day at least a fraction of one man's time is wasted. In a central shop with, for instance, four times as much work as the small shop, the fluctuations in the flow of work are not so extreme, and the excess of labor should be one-fourth or less of that needed in four separate shops, and a more complete equipment can be afforded, from which there will be a saving of labor. Better supervision can be secured, and thus the standard of work for speed and quality of sharpening and tempering

INTERIOR OF SHARPENING SHOP, SHOWING CONVENIENT ARRANGEMENT OF EQUIPMENT

should be higher. When it was decided to equip a central shop, a site was selected nearest to the center of gravity of the work.

Steel and tools are transported on the surface by motor truck and pass through the same shafts as before, with minor exceptions due to changes in operating conditions. A direct road connects the shafts, the distances between them being as follows: Czar to Gardner shaft, 3,800 ft.; Holbrook to Gardner shaft, 2,650 ft.; Gardner to Lowell shaft, 2,850 ft.; Gardner to Sacramento shaft, 3,250 ft. The general arrangement of the shop is shown in Fig. 1.

All day-shift work, underground and surface, stops at 3:30 p.m. At that time the truck begins to collect dull tools from the shafts, which are raised before the end of the shift, and replaces them with others ready sharpened from the shop.

Upon reaching the shop with dull tools, the truck is backed on turnsheet *A*, Fig. 1, and a rough separation of tools is made. All the machine-drill steel from a division is put into its proper car, standing on one of the tracks at *B*, or which may be run out on the turnsheet behind the truck. The picks are taken from the side of the truck and placed in the dull-pick racks, and the miscellaneous tools, of which there are not many, are dumped on the floor near forge *G*. A list of tools and steel from the division is made out by the tool nipper for the truck driver, who turns it over to the shop foreman.

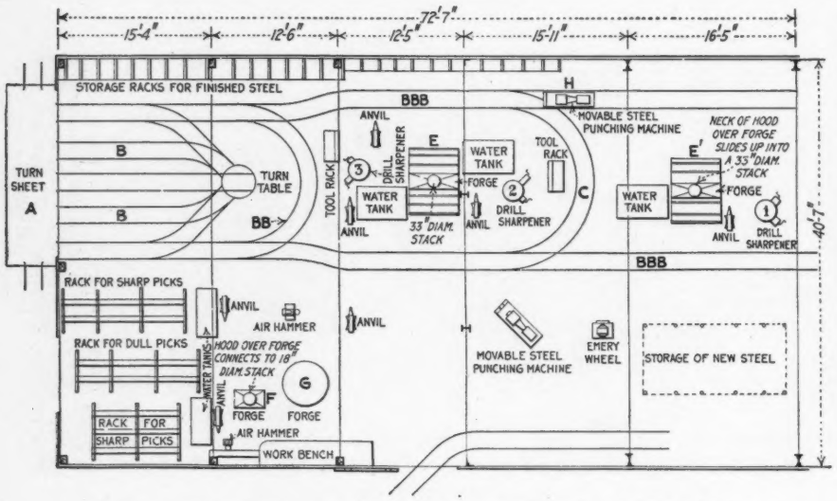


FIG. 1. GENERAL ARRANGEMENT OF CENTRAL DRILL SHOP

Most of the work is done at three oil forges, *E*, *E'* and *F*—the first two for drill steel and the third for picks. The coke forge *G* is for miscellaneous tools. The forge *E'* is not ordinarily in continuous use for sharpening steel, but is used for shanking new and old Leyner steel, etc., and for other repairs.

The tools sharpened are of the following classes: 1¼-in. hollow steel (with bits of five sizes for five lengths of steel); 1-in. solid cross steel (with bits of four sizes); ⅞-in. hollow steel for pluggers; picks; and miscellaneous tools.

The full complement of men employed in the shop is as follows: 1 foreman; 2 machine-drill sharpeners, 2 helpers or heaters (forge *E*); 1 steel repair man, 1 helper (forge *E'*); 1 pick sharpener (forge *F*).

At the beginning of the shift the machine-drill steel from the different divisions is found, each in its own car, on tracks *B*, the picks in the dull-pick racks and the miscellaneous tools near forge *G*. A division car is pushed on the turntable, shop cars are arranged opposite on track *BB*, and all hands but the pick sharpener begin to sort steel. In sorting the steel, each size of each class is put in a shop-car compartment by itself. The steel and tools are again counted, to check the tool nipper's list, so that the same number of each class may be returned to the shaft from which it came.

The object of so thoroughly sorting the steel is to distribute it to the best advantage between sharpeners, and so that dies and dollies will be changed but once for one type and size of bit. The larger bits go to machine No. 3, the smaller to No. 2. The overflow, or steel to be repaired, goes to No. 1. Each machine, however can sharpen any steel, and the load may be shifted from one to the other as it over-balances, always with the intention of keeping down interruptions to straight work, by unnecessary changes of dies or dollies. The steel needing repairs, of whatever kind, is put into a shop car by itself and pushed to a position near sharpener No. 1 on track *BBB*. Sorting takes about 40 minutes, during which time the forges are lighted. As soon as it is finished, sharpening begins.

The routine for sharpening on machines No. 2 and No. 3 is similar. A shop car loaded with dull steel is placed on track *BBB* opposite the forge, convenient to the heater, and an empty one for the sharpener. The steel is heated by the helper and passed to the sharpener, who sharpens it and places it in the proper compartment of the sharp-steel car. The holes in the hollow steel bits are drifted out by the helper on a punching machine *H*, which has been moved to a convenient position. After all the steel is sharpened, it is reheated and tempered, and re-sorted into division cars in a reverse manner. Any shortage due to unfinished repairs, etc., is made up from stock. If there is any time to spare at either of these machines, it may be used in repairing steel. This consists of straightening or clearing plugged steel, etc., or making new shanks. The repair crew clears out plugged drills, straightens them and makes new shanks for broken steel. They also make up new steel as it is required, or sharpen steel if there is more than the regular sharpeners can handle.

The tempering is accomplished by reheating the cold sharpened steels in the oil furnace and tempering them in clear water. The tempering tanks are constructed of wood, 3x4x1 ft. 10 in. There is a depth of water of 1 ft. 4 in., and there is a wire grating 3 in. above the bottom to support the steel while cooling.

The steel is heated by the drill heater and passed to the drill sharpener, who plunges it in the tank and moves it about for a few seconds before standing it up on the grating. The steel is heated only an inch or two back from the cutting edge.

There is a constant flow of water into and out of the tank. The temperature varies in hot weather between 83° and 105° F. In one observed case, after tempering

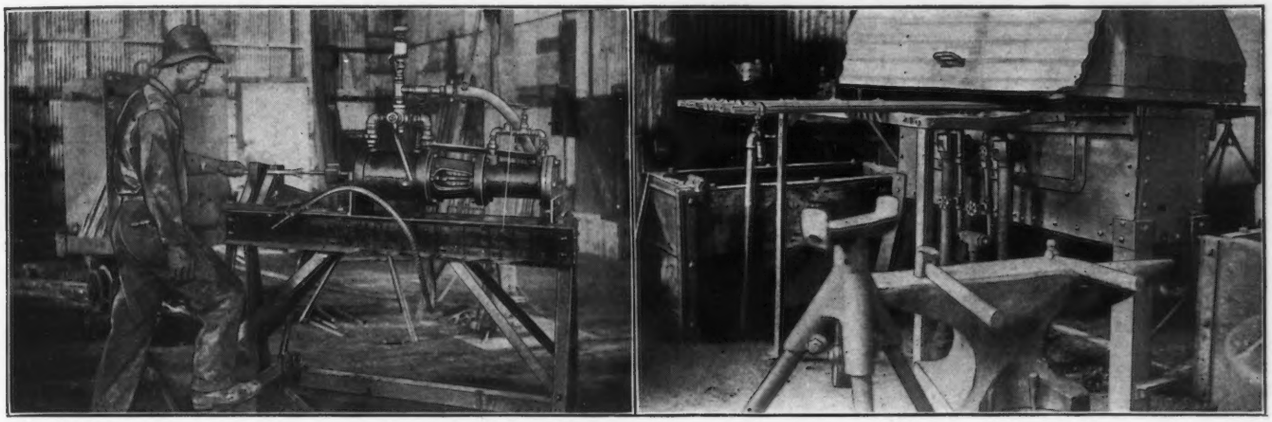
215 bits of 2 1/16-in. gage, the water rose from 83° to 105°, but on continuing the work, it remained at the higher temperature while tempering 135 starters of 2¼-in. gage. If the steel should be overheated, it is plunged and drawn to a color before being plunged for the final temper.

The wire netting is to prevent the bit standing in an accumulation of sludge in the bottom of the tank, which would obstruct the free circulation of water about it. About 220 pieces of 1¼-in. hollow steel are tempered per hour.

The pick sharpener lights his forge and begins sharpening at once. There is nothing unusual in this process, except that both the dull- and sharp-pick racks are within convenient reach, and the arrangement of the forge, anvil, tempering tub and air hammer are in the positions which have been found most convenient. After sharpening, the pick point is quenched, drawn to a good color and then plunged for final cooling. The number of picks varies considerably from day to day. He may finish by noon or perhaps not until two o'clock. Whenever he is done, he replaces broken pick handles, or handles new picks, and is then free to sharpen miscellaneous tools or assist in tempering or re-sorting sharpened steel into the division cars. The shop foreman helps to sharpen picks and miscellaneous tools, tempers steel, sorts and lends a hand generally to whatever crew may need assistance. The work is averaged by keeping a large reserve supply of steel and tools made up and sharpened. In case it is impossible to sharpen all that come to the shop on any particular day, some are drawn from stock and an equal number of sharp tools sent back. The dull tools which are held over are sharpened as soon as possible and put into the storage racks.

There is one Ingersoll sharpening machine of the Leyner type (No. 1) and three Leyner machines of an older pattern (Nos. 2 and 3). A third Leyner is held in reserve, to be used in case of a breakdown. Each sharpening machine has a small mirror attached in such a position that the sharpener from his working position at the levers can see the bit that is being sharpened. They have been used on machines at this property for about three years and are of great convenience.

The oil furnaces are not of unusual design. A sketch of the furnaces used by the Homestake Mining Co. was followed with but slight changes. They are sufficiently large to hold 20 pieces of Leyner steel on each side. They are heated by a light oil of 26° Bé., which is burned in 2-in. low-pressure Case burners. Two burners are used in each of the steel-heating forges, but one in the pick forge. It takes about 4 minutes when the furnace is hot to bring the heavier steel to a working heat, but the heat is moderate and there is little danger of burning the steel. The steel furnaces require relining about every two weeks. The arch across the top, which is separate from the forge, can be replaced without delay as spares are kept on hand and can be set on when desired. The outside of the furnaces is unusually cool. The hoods, which are a little wider and longer than the furnaces, are supported on counterweighted pulleys and telescope into the large stacks. They may be raised when repairing the furnace, but in ordinary operation are lowered until they nearly touch the steel. There is sufficient draft past the steel slot to carry nearly all the waste heat up the stack and away from the workmen. The pick furnace is similar but smaller. It is also double and holds 3 picks on each side. It is relined about every two months.



HOLLOW-STEEL PUNCHING MACHINE AND OIL FORGE AT COPPER QUEEN SHOP

The rate at which oil is burned changes with the speed of sharpening, and no rate per hour can be given. The oil costs about 3.8c. per gal., which sharpens from 9 to 10 pieces of steel. Recently it was measured for 10 consecutive days and on an average 9.34 articles per gallon were sharpened, costing somewhat less than the amount given in the costs, in which the oil was measured less accurately.

It has been found desirable to open the hole in hollow steel deeper than can be done by the pin in the dolly alone. It was formerly the practice to drive a long pin down by hand, the heater setting the shank of the drill into a socket in the floor and holding the drift pin, which was struck by the sharpener. This operation took 0.315 min. for each bit and not only occupied both men, but was fatiguing to the sharpener.

In order to relieve the sharpener of this labor and save time, air-operated punching machines were designed and put into service. The steel is gripped by jaws operated by a foot lever, a valve is thrown by hand and the pin driven down and withdrawn by air pressure in the large cylinder. The smaller cylinder is filled with oil to cushion the stroke. The stroke is so rapid that the

drift pin is not heated by the hot bit. The heater has time to attend to heating the steel, to punch the heated bit and have it ready to the sharpener's hand by the time he is ready for a new piece. The gain of approximately 1/3 of a minute is therefore net. These machines were made up from cylinders on hand. No doubt the design might be improved if new machines were to be constructed. Both before and after sharpening, a jet of compressed air is forced through the steel by the heater or sharpener, to see that the hole is free.

The division cars for holding steel are shown in Fig. 2, the shop cars in Fig. 3 The latter have four compartments, in order to hold as many different sizes as possible. They revolve on the trucks, so that the working section can be turned toward the operator. The pick chutes are shown in Fig. 4. The dull-pick racks are set so that picks slide down toward the sharpener. The sharp-pick racks are sloped the other way, so that they

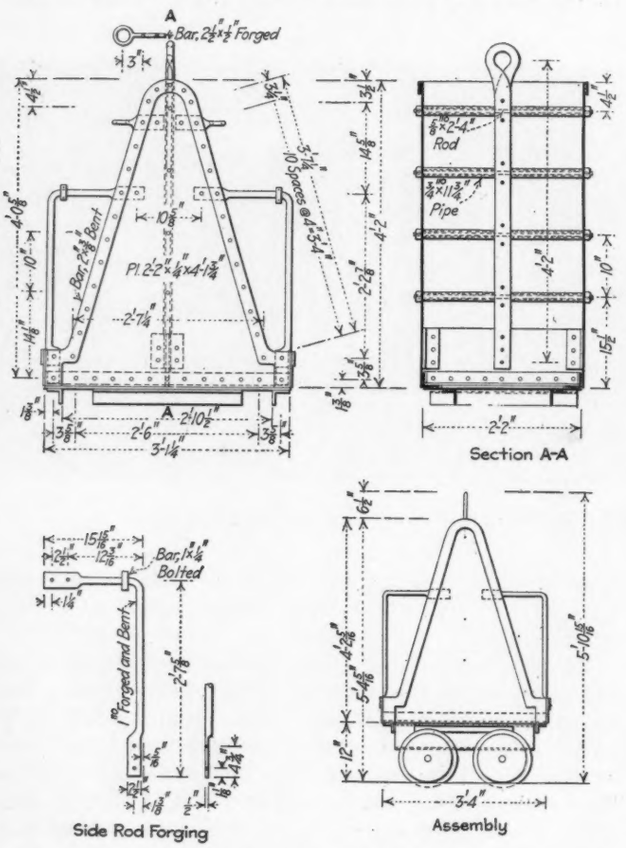


FIG. 2. DETAILS OF DIVISION CAR FOR HOLDING DRILLS

feed to the outside, where they may be reached conveniently when loading on the truck.

A study was made of the conditions of work in detail and as a whole. The equipment for each operation is arranged as conveniently as possible, with the intention of reducing unnecessary motions. The standard of sharpening and tempering has been noticeably raised. Breakage of shanks is increased by running the steel after the bit is dull. This was forcibly shown by a great increase in broken shanks on an occasion when, for a day or two, the bits were not hard enough and the cutting edges battered.

It has not been possible to distinguish in cost between the different articles sharpened. Since they do not differ materially in proportional quantities, a fair comparison with former records may be made by taking the total number of articles sharpened in each case.

When several shops were working, the articles sharpened were as follows:

Articles	Pieces per Day
Hollow steel, 1¼-in. dia.	77
Hollow steel, ¾-in. dia.	103
Solid cross steel 1 to 1⅛ in.	751
Picks	259
Miscellaneous tools	33
Total pieces sharpened per day	1,223

The cost per piece sharpened was:

	Cents
Labor	4.62
Fuel (coke)	1.14
Furnace and power sharpener repairs	0.45
Miscellaneous	0.18
Total cost per piece sharpened	6.40

The rate of pay was $4.71 per day for all men employed. Details of the items, furnace and power sharp-

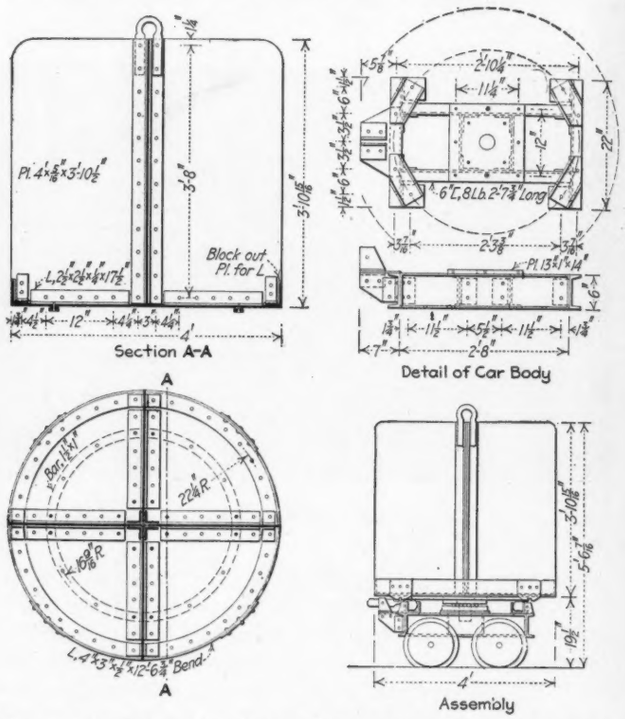


FIG. 3. DETAILS OF FOUR-COMPARTMENT SORTING CAR

ener repairs and miscellaneous, are not known so accurately, nor are total charges so correct as shown by records in the new shop.

The new shop has been in operation for a little more than a year. The following is a tabulation of work and costs:

ROUTINE ARTICLES SHARPENED

	July, 1915	Average per Day	December, 1915	Average per Day
1¼-in. hollow steel	8,921	343	13,473	499
¾-in. hollow steel	2,174	84	2,703	100
1-in. solid cross steel	15,996	615	13,221	489
Picks	6,009	231	6,482	240
Miscellaneous tools	634	24	751	28
Totals	33,734	1,297	36,630	1,356
Picks rehandled	268	10	351	13
Steel repaired	2,425	94	2,670	99

As will be seen, the following figures cover every item entering into the cost except the overhead which is omitted in every case; these being only operating costs. The relative number of the different sizes is interesting and the relative cost as affected by the quantity.

NEW-SHOP COST OF SHARPENING

	Total for July	Cost per Piece	Total for December	Cost per Piece
Labor	$1,057.29	3.13c.	$1,081.21	2.95c.
Sharpener, Repairs } Labor material	75.74 161.37	0.22c. 0.48c.	97.01 88.52	0.26c. 0.24c.
Furnace repairs	7.38	0.02c.	16.84	0.05c.
Fuel oil	156.57	0.46c.	148.45	0.41c.
Compressed air	103.44	0.31c.	102.00	0.28c.
Miscellaneous	5.47	0.02c.	4.03	0.01c.
Surface transportation	.....	0.25c.	.....	0.25c.
	$1,567.26	4.89c.	$1,538.06	4.45c.
Average wage	$4.65 per shift		$5.17 per shift	

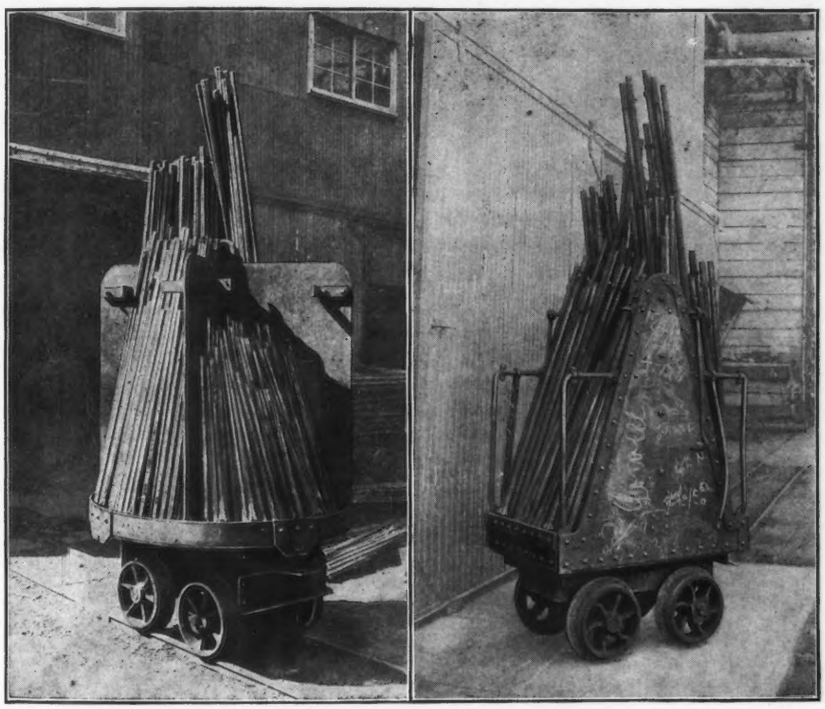
NEW STEEL CUT, MADE UP, SHARPENED AND TEMPERED

	Pieces in July	Pieces in December
1¼-in. hollow steel	351@15c.	437@17c.
⅞-in. hollow steel	250@ 9c.	105@10½c.
1-in. cross steel solid	903@ 5½c.	60@ 6½c.

COST OF CUTTING, FIRST SHARPENING AND TEMPERING

Labor	$100.25	$73.40
Sharpener repairs	2.19	1.47
Furnace repairs	1.47	.94
Fuel oil	12.27	7.85
Compressed air	8.10	5.40
Miscellaneous	.54	.16
	$124.82	$89.22
Total cost of operation	$1,692.08	$1,627.28

This cost of making up steel is estimated from short-time records of shop work. If there is an error, it is an underestimate of the cost of making up steel, which would be to the disadvantage of sharpening costs. The cost of repairing steel and rehandling picks is included in amounts charged, but the numbers repaired do not appear in the divisor when obtaining the cost per piece handled, since there are no records of steel repaired, etc., in the earlier costs with which comparison is made.



THE SORTING CAR AND DIVISION CAR IN USE

Since the use of hollow steel has increased from 200% to 325% and the operations of sharpening and repairing this type of steel are more costly, the comparison is to the disadvantage of recent work. This steel was formerly shanked in the central blacksmith shop and was so much more costly that a comparison is not of value.

Records of two months' work are given in detail. They were selected as being representative. In December the shop was operated nearly at capacity and, in spite of a higher wage scale, the lowest costs were made. Average costs for routine sharpening during the last six months of 1915 would be 4.59c. per piece sharpened, as compared to 4.64c. and 4.20c. respectively in July and December. This is exclusive of transportation.

RECORD OF OPERATIONS IN MAKING UP 258 PIECES OF 1¼-IN. STEEL FOR INGERSOLL-LEYNER NO. 18 DRILL

Operation	Number Pieces	Labor Cost	Cost per Piece	Time per Piece
Shanking	258	$18.83	7.3c.	3.39 min.
Bitting	258	5.52	2.14c.	0.996 min.
Tempering shanks	258	3.46	1.34c.	1.24 min.
Tempering bits	258	1.22	0.47c.	0.44 min.
		$29.03	11.25c.	6.04 min.
Repairs and miscellaneous	....	1.92	0.74c.	
Fuel, etc	....	2.58	1.00c.	
Totals		$33.53	12.99c.	

The steel made up at the foregoing cost was: 80 starters with 2¼-in. bits; 80 seconds, 2 1/16; 80 thirds, 1⅞; and 18 fourths with 1 11/16-in. bits.

The temper was drawn on shanks, but the bits were plunged. In this operation seven men were employed—three sharpeners, three helpers and the foreman, who tempered the steel and did other miscellaneous work. The steel was delivered already cut into lengths. Lost time due to starting fires, etc., is included in the cost. This work was at an unusual rate. It is not believed that it would be equaled in regular routine. In this day's work, the pieces prepared for sharpening did not use up the whole day. The repairs, miscellaneous charges and fuel were estimated from ordinary running expenses.

The motor-truck crew consists of a driver and one or two Mexican helpers. The labor cost of operating the truck for the second half of 1915 was at the rate of 1.46c. per min. or, since the average time occupied was about two hours, $1.78 per day. The cost of truck maintenance and repairs, exclusive of depreciation, is 22.2c. per mile. A round trip beginning at the supply-department garage and returning to the same point is 4.7 mi. and costs $1.045 per day. The cost of surface haulage per piece for the whole number sharpened, to compare with former costs, is 0.25c. Since tools for the Gardner shaft were not delivered by truck, those actually transported cost 0.37c. each. The sharp steel, picks, tools, etc., are loaded on the truck at the shop at the rate of 67 pieces per minute, and 118 pieces per minute are unloaded at the shaft. The dull tools are loaded on the truck at the shafts at the rate of 46.3 pieces per minute, and 61.9 pieces per minute are unloaded at the shop and placed in cars or racks.

Some Special Speed Tests

A few tests have been made to determine the maximum rate of sharpening different tools. No special preparation was made, but the men were asked to speed up. The runs started with tools hot in the furnace and stopped with an equal number heated and ready for sharpening. In these speed tests the bits and pick points were required to pass inspection. The picks were tempered, but not the

steel. These rates could not be maintained throughout a day's work. A sharpener and helper handled the cross and hollow steel, and a sharpener without helper did the picks.

SOLID CROSS STEEL

Number Pieces	Size of Bit, In.	Time Occupied, Min.	Pieces per Min.
60	1 13/16	12.24	4.9
60	1 5/8, 1 7/16	11.74	5.11

HOLLOW STEEL

60	2 1/4	16.90	3.55
60	2 1/16	12.05	4.98

PICKS

25 (50 points)	25.66	0.97

Of the 50 pick-points, nine were drawn out under the air hammer.

The design of the shop and scheme of operation were matters of growth, and many individuals of the mine staff, from the master mechanic and efficiency engineers to the shop employees, rendered valuable assistance in developing the problem and solving it so successfully.

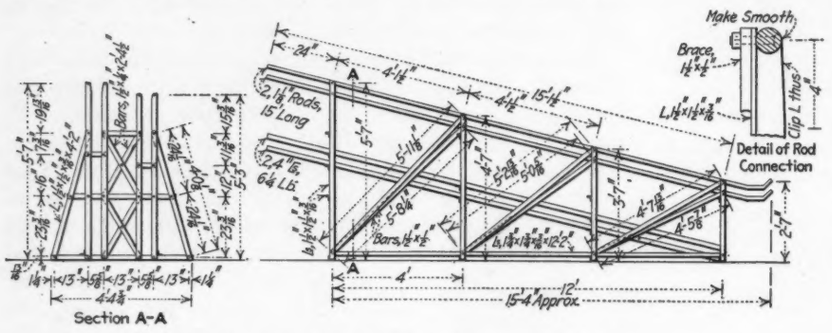


FIG. 4. DETAILS OF DRILL-PICK RACK

British Broken Hill Proprietary

The report of the directors of the British Broken Hill Proprietary Co., Ltd., for half-year to Dec. 31, 1915, states that contracts have been made for sale of the output of carbonate ore for three years, and the proceeds from this contract are sufficient to cover present expenditures at the mine. The stock of lead concentrates remaining on hand was sold for shipment to Japan in January and February, but the strike that occurred at Broken Hill delayed the commencement of deliveries, which are now, however, being made.

As the result of an application made by the company under the provisions of the Trading with the Enemy Amendment Act, 1916, the Board of Trade has made an order, dated May 12, 1916, determining the contracts made in 1910 and 1912 for delivery of the company's output of lead and zinc concentrates over long periods to German smelters. The directors are consequently at last in a position to negotiate for the disposal of the company's production elsewhere, and the question of how most advantageously to deal with the mine's future output is one that has been, and is, engaging the board's most earnest consideration.

Negotiations were in progress with Japanese buyers for a further sale of concentrates on a scale that might have enabled the company to enter upon more active operations and resume milling, but these negotiations have been stopped, owing to the action of the commonwealth government in prohibiting the further export of lead concentrates from Australia for the time being. Such a policy is incomprehensible to the directors, seeing that there are no facilities at present in Australia for smelting the company's output on satisfactory terms, and that of the mines at Broken Hill that are producing, not one is working to its full output.

If the commonwealth government should persist in prohibiting the export of the company's lead concentrates from Australia after the war, the company would be compelled to enter into arrangements for smelting or having them smelted in Australia, though the directors, after full inquiry, are decidedly of opinion that this course could not possibly be advantageous to the company and that it would be preferable, on many grounds, that the company should itself undertake the operation of smelting and for this purpose should erect works equipped with the most modern form of plant within the United Kingdom, where both lead and zinc concentrates could be treated at lower cost than in Australia, particularly in view of the comparatively low grade of ore obtained at the mine.

In regard to zinc concentrates an association, to be called the Zinc Producers' Association Proprietary Ltd., is in course of formation in Melbourne, under the auspices of the Commonwealth government, with the object of securing that the future output of these concentrates produced in the commonwealth shall be realized through one channel. The principal producers at Broken Hill have already agreed to join the proposed association, and this company has agreed to concur with the other British companies concerned by also joining, subject to the contract that has to be entered into being so framed as to reasonably protect and safeguard this company's interests, and to this company having the right, if and when it thinks fit, to establish its own works for the treatment of its zinc concentrates, with the stipulation that the spelter produced shall be realized through the medium of the association.

Reserving Mineral Rights in Land Sold

By A. L. H. Street*

In Mtynarczyk vs. Zyskowski, 157 Northwestern Reporter, 566, it was doubtless easier for the Michigan Supreme Court to pronounce the following rule of law than it was to pronounce the names of the litigants:

Where a reservation of mineral rights was inserted in a deed in violation of a contract of purchase and without the grantee's knowledge or consent, the deed was subject to cancellation as being fraudulent.

A Standard Test Screen Scale—Plans have been completed for a conference of representatives of various committees of engineering and industrial societies at which it is proposed to discuss the preparation of a standard scale of sieves for the use of all industries employing fineness tests. Two proposed scales have been agreed upon tentatively, one based on integral metric units and the other on the customary units, and the conference has been arranged with a view to their final adoption. Following the preparation of specifications for each of the sieves the United States Bureau of Standards will be prepared to extend the list of sieves which it tests and certifies to include this series of standards.

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Properties of Slime Cakes--II*

By E. E. Free†

SYNOPSIS—Porosity includes three concepts—the amount of pore space, the size of the pores and the continuity of pore spaces. The first controls water retention and the other two control permeability. The theory of permeability is outlined and practical discrepancies are explained.

In previous articles all the factors known to be contributory to the colloidality of slimes have been discussed. Before proceeding to the matter of porosity of slime cakes, it may be profitable to summarize a little more formally the conditions tending to produce or to decrease an excessive colloidality. The necessary conditions for the production of a colloidal slime are two: (1) Great fineness of particle of at least a part of the slime; (2) a low degree of flocculation of this finely divided material. Both conditions are necessary. Neither is sufficient alone. It is useless to enter here into the question of fineness of particle or its possible control. Usually such a degree of control as would entirely or almost entirely prevent the production of very fine material is not practicable, and no less degree of control will be of much assistance against colloidal troubles. The degree of flocculation will be increased by dissolved salts and acids in practically all concentrations and by alkalies in certain concentrations, mostly high. It will be decreased by low concentrations of some alkalies and by the presence of gelatinous coatings, in the rare cases when these are present. There are also many variations in the degree of flocculation the causes of which are not yet understood. Apparently the surface alteration discussed in this article tends to decrease the degree of flocculation, but this is not entirely certain.

Control of the Colloid Condition

Ignoring many minor uncertainties and assuming a slime of constant fineness, rules for practical procedure may be stated thus: Colloidality will be increased by (1) the presence of small amounts of free alkali (except lime), (2) prolonged grinding or long exposure to water or the atmosphere, (3) grinding or storage at high temperatures, (4) the presence of organic materials such as would be supplied by decaying animal or vegetable matter. Colloidality will be decreased by the avoidance of the four conditions just cited and also by (1) the presence in solution of acids or of neutral salts or of certain alkalies in certain concentrations and (2) rapid grinding and handling. The relative quantitative importance of the various factors mentioned and the decision as to which should be selected as a means of practical improvement will depend upon local conditions different in each case. In general the presence of organic matter has the most effect, but is rarely encountered. Next in quantitative importance are the presence of dissolved acids, salts or alkalies. Of much less effect is the time of grinding, or storage, unless it runs into years, and of still less effect are changes of temperature between usual limits.

Turning now to the matters of porosity and permeability, we again encounter a confusion of terms. By "porosity" different people mean one or more of three entirely different things: (1) The amount of pore space, (2) the size of the pores and (3) the continuity of the pores. It is justifiable to call porous, say, a tin colander, a piece of pumice and a Swiss cheese. However, the colander is freely permeable to water, the pumice much less so and the cheese not at all, whereas both the pumice and the cheese may have a much larger amount of pore space in the same volume or cross-section than has the colander. It is unnecessary to amplify the illustration in order to make manifest that we must keep a clear distinction between these matters of pore space, pore size and pore continuity. The word porosity we shall drop altogether for the present.

Turning first to the matter of amount of pore space, it is convenient to consider a special case—that of uniform spherical particles piled together. Several uniform and symmetrical arrangements are possible, ranging from the loosest possible piling where each sphere touches four others to the closest possible piling where each touches twelve others. It has been shown by Slichter[1] that the percentages of pore space (by volume) in these two cases are 47.64 and 25.95 respectively, and that these percentages are independent of the diameter of the spheres so long as all be uniform. In a thickened slime the particles are not all spheres nor are they of uniform size. It ought to be possible for irregular particles to fit together more closely than spheres could do and also for the smaller particles to enter and partly fill the spaces between the larger. It would be reasonable, therefore, to expect slime cakes to have even less of pore space than the lower limit given. As a matter of fact exactly the reverse is true.

The normal slime mass, thickened by free settling instead of having less pore space than that of an assemblage of uniform spheres, frequently has more than the spheres could hold even with their loosest packing. The usual 40 or 50% of water in such thickened slimes corresponds, when allowance is made for specific gravity, to 60 or 70% of pore space. It is customary to explain this unexpectedly high percentage of pore space as due to films of water held about the particles and preventing actual contact. It is probable that something of this sort really occurs, but it is not necessary to assume it in order to explain the facts. Particles of irregular shapes may arrange themselves more loosely as well as more closely than spheres. Bricks, for instance, if piled end to end, may be arranged in an open structure containing considerably more than 45% of pore space. If we join to this the conception of partial cementation of particles or even of a resistance to sliding over each other such as might be due to a sticky surface, it is easy to conceive a permanent structure still more open. If the bricks of the previous illustration be held together by mortar, they can be built into a permanent structure—for instance, a house—in which the amount of pore space is many times the amount of solid material.

*This is the ninth of a series of articles dealing with the subject of "Colloids in Ore Dressing." Former papers appeared in the issues of Feb. 5, Mar. 4, Mar. 18, Apr. 15, Apr. 29, May 20, June 3 and June 17, 1916.

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[1]U. S. Geological Survey, Nineteenth Annual Report, Part II, p. 306 (1899).

The practical deduction is that the amount of pore space is controlled much more largely by the structure of the mass—that is, by the mutual arrangement of the particles—than it is by the size, shape or other nature of these particles. The retention of water in slimes thickened by sedimentation is more a matter of the arrangement of the particles than of their character. With filter cakes formed by pressure or suction, this is not so strictly true, but even in this case the structure of the slime mass is of extreme importance. Obviously there are matters with which the degree of flocculation will have much to do.

Practically the amount of pore space is usually less important than the permeability of the mass to percolating solutions. Considered from this point of view, the slime cake is a mass containing innumerable tiny capillary tubes through which the solution must flow. The formula commonly employed for the flow of liquids through such capillary tubes is due to Poiseuille[2] and is

$$Q = K\frac{hd^4}{l}$$

where Q is the rate of movement of the liquid, h is the head or driving force, d and l are the diameter and length of the tube respectively and K is a constant depending, among other things, upon the viscosity of the liquid. The formula includes two assumptions: (1) That the tube is very long in comparison to its diameter, and (2) the flow is either at constant velocity or so nearly so that the energy change due to change of velocity is negligible in comparison with that due to friction or to change of head. It has been found experimentally by Seelheim[3] that this formula holds quite well for the percolation of water through sand, clay and powdered chalk, and Bell and Cameron[4] have applied it successfully to the expression of the movement of water and solutions through filter paper, soil and other porous media. If one imagines a slime cake of uniform particles uniformly arranged and of uniform thickness, the d of this formula will be the distance between the particles and the l, the thickness of the slime cake. The h will represent the effective head, or difference in pressure between the two sides of the cake. It is apparent that the rate of flow ought to vary directly as the head, inversely as the thickness of the slime cake and directly as the fourth power of the distance between the particles.

This formula is not in very good accord with the results of metallurgical experience. Experiment and practice agree that the rate of percolation decreases with increasing thickness of slime cake considerably more rapidly than in the direct proportionality which is required by the formula.[5] Similarly, in some cases at least, the rate of flow increases with increase of head rather less than the formula predicts,[6] and the difference in rates of flow with sands of different size is also considerably less than would be indicated. According to the formula the increase of particle diameter by ten would increase the rate of flow ten thousand fold. In practice the difference is usually much less and apparently is proportional to a lower power of the diameter than the fourth.[7]

In the existing dearth of precise experimental evidence it will not do to be dogmatic, but there exist certain known factors modifying the formula of Poiseuille which seem sufficient to explain the various discrepancies noted. First, as to the more than proportional decrease of flow which follows increase in the thickness of the cake, it seems probable that this is related to the third factor mentioned as contributing to the usual conceptions of porosity, namely, the continuity of the pores. Pores in a slime mass are not straight holes directly through the mass, but very tortuous passages, many of which are entirely plugged and allow passage of water only by sidewise communication with neighboring passages. It follows that increase in thickness of the slime cake will increase the effective length of pores in greater proportion. This factor of tortuosity of the passages can scarcely be formulated mathematically, but it seems competent to account for the discrepancies between formula and fact so far as thickness of the slime cake is concerned.

The relation of rate of flow to size of particle is, strictly speaking, a relation to the size of the interstices between the particles, but with uniform size and arrangement of particles this will bear a constant ratio to the diameter of the particles and the d of the Poiseuille formula may be taken as this diameter. The formula requires that the rate of flow should vary with the fourth power of this diameter. That it seldom, if ever, does so in fact is probably due to the failure of usual metallurgical conditions to satisfy one of the assumptions upon which the formula is based, namely, that the capillary tubes through which flow is occurring must be very long relative to their diameter. For obvious practical reasons beds or slime cakes of fine particles cannot be made too thick, and they are probably not thick enough for complete conformity with the conditions postulated by the formula. It is to be expected, therefore, that the true formula for flow through the interstices of slimes will carry a power of the diameter of particle lower than the fourth but higher than that included in the formulas for flow through pipes of finite length or through orifices, in which formulas the power of the diameter is usually between the second and third. More detailed analysis is unnecessary. The practical conclusion is that the actual rate of flow will vary directly with an undetermined power of the diameter between the second and fourth. A change in diameter of particle will produce a relatively much larger change in the rate of percolation. Thus stated, the principle is in full accord with experience[8] and

TABLE 1. TEMPORARY AND PERMANENT FLOCCULATION OF KAOLIN SUSPENSIONS BY DIFFERENT CONCENTRATIONS OF CALCIUM CHLORIDE

Concentration $CaCl_2$ (Grams per Liter)	Percentage Increase of Volume by Flocculation: Total (Temporary and Permanent	Permanent Only
500	624	160
100	467	121
25	460	122
5	496	111
1	512	119
0.05	391	94
0.01	169	87
0.005	0	0

[2] "Ann. Chim. Phys.," Series 3, Vol. VII, p. 50 (1843).

[3] "Zeits. anal. Chem.," Vol. XIX, pp. 387-418 (1880).

[4] "Jour. Physical Chem.," Vol. X, pp. 658-74 (1906).

[5] This is shown very clearly by the experiments of Young cited in the bibliography, as well as by the large amount of mill experience with vacuum filtration processes which is now available.

[6] Sweetland, "Min. and Sci. Press," Vol. XCIX, p. 853 (1909); Young, loc. cit., pp. 846-851; Warwick, cited in bibliography.

[7] It is perhaps well to point out that these and following deductions apply equally to percolation under gravity head, to pressure filtration or to vacuum filtration. The means by which the percolation head is applied have no importance in consideration of the properties of the slime cake.

[8] See also Hatschek, cited in bibliography.

immediately makes clear the reason for the low permeability of colloidal slime cakes. The characteristics of such slimes are extreme fineness of particle and low degree of flocculation. The pore spaces are very small, and the rate of percolation is decreased in still greater ratio. It should be noted that this matter is entirely one of the sizes of individual pores and has no necessary relation to the total amount of pore space. A sand composed of spherical particles one millimeter in diameter will have the same pore space (when similarly packed) as one with particles 0.1 mm. in diameter, but will have a permeability hundreds if not thousands of times greater.

It is obvious that flocculation must have great importance to this matter of permeability. Under most conditions a floccule will behave like a single particle of larger diameter. It follows that if the floccules remain as such in the thickened slime, flocculation will greatly increase the permeability as well as the pore space. This is not because the percentage of pore space is greater, for that percentage is determined largely by the internal spaces between the constituent particles of the floccule. The increase of permeability occurs because the pore spaces between the floccules are individually larger.

The Permanence of Floccules

It must not escape attention that this conclusion includes the very important assumption that the floccules persist as such in the settled or thickened slime. That this is not entirely true is suggested by some recent experiments made by Dr. F. K. Cameron, H. F. McCall and me. Working with kaolin and quartz powders in various flocculating solutions, we have found that the degree of flocculation existing temporarily during sedimentation is considerably greater than that existing after all the floccules have settled and have become compacted as fully as will happen under the impulsion of their own weight. However, the final, permanent degree of flocculation is not zero, but may be considerable. As an example, there are given in Table 1 the temporary and permanent degrees of flocculation of kaolin in solutions of calcium chloride. In general, one may conclude that a part of the flocculation existing in normally flocculated slimes is temporary only and will vanish on thickening, but that another part is permanent and will persist. The numerical ratio of the permanent to the temporary flocculation undoubtedly depends upon many factors, most of which are imperfectly understood. It is useless to attempt precise generalization, but one imagines that in most cases the degree of flocculation after settling will bear some relation to the degree before and that slimes that are well flocculated and that settle readily will tend also to be satisfactorily permeable. Undoubtedly many exceptions will be encountered, but the conclusion as stated seems in substantial agreement both with theory and with practice. The converse conclusion that nonflocculated slimes settle to impervious masses needs no demonstration.

It is probable that this matter of the relative permanence of floccules lies at the root of the third discrepancy between the Poiseuille formula and practice, namely, the observation that increase of head does not always induce a fully proportional increase in the rate of percolation.[9] Even those floccules that are nominally persistent must be held together by comparatively weak forces. The experimental fact that most of flocculation originally existing in the suspension does not persist indicates that the floccules yield readily to the relatively small pressures due to the weight of the mass itself. A percolation head acting on such a mass operates in many ways like an increase of gravity or of mechanical pressure on the slime mass, and it is probable that many floccules which otherwise would persist are broken down thereby. One concludes that an increase of head may produce an increased consolidation of the slime mass with a resultant narrowing of the pore spaces and a decreased permeability. The rate of percolation may not actually decrease, but it fails to increase as much as would correspond to the increase of head. An explanation is provided also for the reported effect of sudden variations of head or of exposure of slime cakes to the air in decreasing permeability and for the observation which the writer has once or twice run across that slimes settled under conditions of much vibration from neighboring machinery are more compact than when settled without such vibration.

The Function of Sand in Slime Filtering

From similar consideration one may deduce an explanation of the common experience that the addition of a proportion of coarse sand to a colloidal slime greatly increased the rate of percolation.[10] A certain direct effect is to be expected from the simple presence of the coarser material, but it is probable that there is an even more important effect in increasing the persistence of the floccules. The coarser sand grains, being rigid and of considerable strength, relieve the floccules of a large part of the total compressive stress and protect them in the same way that the heavy compression members of a building frame take the main load from the weaker lateral members, leaving these latter to carry only the lesser transverse stresses necessary to maintain equilibrium. The analogy is not perfect, but it will suffice to illustrate one possible function of the added coarser material and one that seems sufficient to explain the facts observed.

In conclusion we may note briefly the effect of varying temperature upon the behavior of settled slimes. As was mentioned in the second article, there is some evidence that although increase of temperature promotes settling, it does not increase the degree of flocculation, but rather decreases it slightly, the more rapid subsidence being due altogether to the lowered viscosity of the water. If this be true, slimes settled at higher temperatures should be more compact and should contain both smaller pores and a lesser percentage of pore space. The evidence for this is by no means conclusive, but it is borne out by the observation of Salkinson[11] that an increase of 6° F. in the temperature of the system produced a diminution of 8 in. in a 5-ft. column of the thickened slime. At first sight it would be reasonable to extend these observations to the matter of permeability and to infer that since slimes are more compact at higher temperatures, the permeability will then be less. Indeed, this really may be true of permeability as distinct from rate of percolation. I am acquainted with no evidence. It is a commonplace that the rate of percolation (or filtration) is greater at higher

[9]It must be remembered that permeability and rate of percolation are not interchangeable terms. The permeability is a property of the slime mass. The rate of percolation depends on this property and also on the head and the properties (mainly the viscosity) of the percolating liquid.

[10]See, for instance, Megraw, "Eng. and Min. Jour.," Vol. XCVII, pp. 1057-58 (1914).

[11]"Journ. Chem. Met. Min. Soc. S. Africa," Vol. VII, pp. 403-6 (1907).

temperatures, but the cause of this may lie altogether in the lowered viscosity of the water or solution. It is too often forgotten that mill problems are concerned as much with the behavior of water and of aqueous solutions as with the behavior of mineral particles. The many and important influences of the changing viscosity of water are far too little appreciated.[12]

The Summary of Data on Permeability

In summary, porosity includes three distinct features: (1) The amount of pore space, (2) the size of the individual pores and (3) the continuity of these pores. The retention of water by thickened slimes is a matter of the amount of pore space. Permeability is a matter of the size and continuity of the individual pores without regard to their total amount. The amount of pore space (which means the percentage retention of water) is affected relatively little by the size and character of the particles of the slime and relatively much by the mutual arrangement of these particles—that is, by their degree of flocculation. This degree of flocculation is usually greater in the suspension before subsidence than in the settled slime after subsidence is complete, which means that only a part of the initial flocculation is permanent. Only this permanent flocculation is effective in increasing pore space or pore sizes. The amount of the permanent flocculation is decreased by increased pressure on the slime cake or by mechanical vibration or jar.

The rate of percolation or filtration depends upon the thickness of the slime cake, the diameter of the particles composing it and the differential pressure or head of the percolating solution. It has no necessary relation to the amount of pore space. It will decrease with increase in thickness of the slime cake but in somewhat greater proportion, the precise ratio depending upon the degree in which the capillary passages through the slime cake are indirect and tortuous. This tortuosity will depend, in turn, upon the fineness of particles and the degree of permanent flocculation.[13] The rate of percolation will increase with the head but in somewhat less ratio, the departure from exact proportionality being dependent upon the extent to which the pressure of the increased head destroys floccules and reduces the degree of permanent flocculation. The permeability (and rate of percolation) will increase with increase in the mean diameter of the particles and according to a power of this diameter between the second and the fourth. The actual power of the diameter effective in any given case will rise with increasing thickness of the slime cake or with increasing tortuosity of the passages through it. Permanent flocculation will increase the permeability greatly by raising the effective mean diameter of the particles. The permanent flocculation increases both the amount of pore space and the permeability, the former largely because of the spaces interior to the floccule and between its component particles, the latter because of the increased size (not amount) of the exterior spaces between the floccules. Increased temperature appears to decrease slightly the amount of pore space in the settled slime. It increases the rate of percolation probably entirely because of the decrease in the viscosity of water.

[12]Cf. Caetani, "Min. and Sci. Press," Vol. CVI, p. 442 (1913).

[13]The literature of plasticity is very extensive and the following articles will serve as summary and introduction. On permeability, pore space and the theory of percolation and filtration the literature is very meager. I am acquainted with no adequate general treatment. Three of the more important special articles are cited below, and others, still less general, have been cited in the text. Reference should be made also to the standard textbooks, especially Richards' "Ore Dressing."
Cushman, Allerton S., "The Cause of the Cementing Value of Rock Powders and the Plasticity of Clays," Journ. Amer. Chem. Soc.," Vol. XXV, pp. 451-68 (1903).
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Hatshek, Emil, "The Mechanism of Filtration," "Journ. Soc. Chem. Ind.," Vol. XXVII, pp. 538-44 (1908).
Warwick, A. W., "Conditions Governing the Washing of Filter Cakes," Min. and Eng. World," Vol. XXXVIII, pp. 797-99 (1913).
Young, George J., "Slime Filtration," "Trans. A. I. M. E.," Vol. XIII, pp. 752-84 (1911).

Canadian Mineral Resources

At a meeting of the Anglo-French Exploration Co., at London, Apr. 28, 1916, J. B. Tyrrell, Canadian representative of the company, offered some remarks regarding Canada as a field for mining investment. Mr. Tyrrell said, in part, that the building of the Canadian Pacific Ry. opened a new era in mining in Canada. It gave access to a new and previously inaccessible country; it opened up new mining districts, and in a rock-cutting on the railway itself there was exposed for the first time the vast nickel deposit near Sudbury. A new interest in mining was stimulated, and as a result the mineral production rose in 1890 to a value of £3,450,000, or at the rate of 14s. per head of population. During the next 5-yr. period development and production progressed slowly, but steadily, and in 1895 the output of the country had reached a value of £4,200,000. In the following year the gold placers of the Klondike district were discovered, and by 1900 the mineral output of Canada had jumped to £13,250,000, or 50s. per head of population. In five years the mineral production of the country had been trebled. About one-half of this increase, or a third of the total production, was derived from the gold of the Klondike, but the other half was attributable to a general development of the mineral resources of the whole country and to the keen interest which the people were taking in all mining enterprises.

After 1900 the production of the placer mines of the Klondike began to decline, and by 1905 it had decreased from £4,600,000 to £1,600,000 a year, but notwithstanding such a heavy drop in the output of that extraordinary camp in far Northern Canada, mining had been so active throughout the Dominion that the total mineral production had increased to a value of £14,200,000 a year. Shortly before the close of this last 5-yr. period a new silver-bearing field had been discovered in a rock-cutting on a new railway line in the midst of the pine forests of northern Ontario, but as yet its influence had been only slightly felt in the statistics of the mineral production of the whole country. The center of this district is now the town of Cobalt, and up to the end of December last it had produced 234,000,000 oz. of silver.

In 1910, at the end of the succeeding 5-yr. period, Canada's annual mineral production had increased by £7,800,000 to a total of £22,000,000; £3,000,000 of this increase was due to the output of silver from Cobalt, while £4,800,000 was due to a general acceleration of mining activity throughout the whole country. During the five years just past the mining industry has been making steady progress, and in 1915 Canada yielded mineral

wealth to the value of £28,500,000 or 74s. per head of the population. The average annual increment of increase in mineral production for the ten years 1905 to 1915 has been £1,400,000. Most of the knowledge possessed of the country has been acquired by people who live in the southern border region, and such knowledge refers to the border region itself or to the country immediately continguous to it. Within or near this southern border are the great nickel mines of Sudbury, the silver mines of Cobalt, the gold mines of Porcupine, the copper mines of Quebec and most of those of British Columbia, the asbestos mines of Quebec, and the great coal fields of Alberta.

Beyond the populated and partly developed southern border land is a vast area that is still untenanted and unprospected. The means of transportation into it are imperfect, and no local supplies of food are available, so that even if men should penetrate into it, they would be unable to live and work in it until they could obtain a regular supply of provisions from the settled country to the south, which they might supplement later by clearing the land of its forest growth and raising provisions for themselves. But transportation facilities are being gradually improved all the time, and with these improvements the men who are scattered along the borders of civilization and have begun the development of the country behind them continue to push on farther into the wilderness. In this way, through the enterprise of restless but experienced men, inured to every kind of hardship, the unknown lands are explored and prospected, while the fuller development of the mineral and other resources of the country behind them is left to others drawn from the larger centers of civilization.

British Mineral Production, 1915

An advance report (subject to revision) from the British Home Office gives the following figures of mineral production, in long tons, under the Coal Mines Act during 1915: Barium compounds, 7,477; clay and shale, exclusive of fire-clay and oil shale, 236,506; fire-clay, 1,839,746; igneous rocks, 79; iron pyrites, 9,255; ironstone, 6,080,218; limestone, 4,464; oil shale, 2,998,652; sandstone, including ganister, 141,420. Under the Metalliferous Mines Act, the following were produced: Arsenic, 2,496 long tons; barium compounds, 53,324; bauxite, 11,723; chert, flint, etc., 3,033; clay and shale, 86,202; copper ore and copper precipitate, 746; fluorspar, 25,577; gold ore, 5,086; gypsum, 204,574; igneous rocks, 43,010; iron ore, 1,795,887; iron pyrites, 1,280; lead ore, 20,698; limestone, 283,216; manganese ore, 4,640; ocher, umber, etc., 4,030; rock salt, 131,348; sandstone, including ganister, 57,626; slate, 48,893; tin ore, 6,805 (of which 385 tons were undressed); zinc ore, 12,057 long tons.

These figures do not represent the total mineral production, as the quantity of minerals, including iron ore, limestone, etc., produced under the Quarries Act has not yet been reported. The totals for coal and for the ores of copper, lead and zinc are probably substantially complete.

Coal production in 1915 from all mines and openpits was 253,180,000 gross tons, as given in the *Journal* for May 6 last. The number of persons employed at mines under the Coal Mines Act was 953,642.

What's the Matter with Leadville?

LEADVILLE CORRESPONDENCE

The old camp of Leadville does not create much disturbance on stock exchanges. Stock speculators seldom think of this famous district in central Colorado that began producing metal way back in 1860 and has never let up. The exchanges do not carry any Leadville stocks; they are never quoted. The district is therefore different in this respect from the majority of the American mining districts of the present day. Whereas mining activities never cease and production is steadily maintained from many properties, owners and operators can see no possible benefit to be derived from promiscuous selling and transferrence of stocks. To a certain degree this is due to the ownership of most of the mines being vested in single individuals or in close corporations.

Again, Leadville seldom figures publicly in mine promotions. This does not mean that new mines or companies are not occasionally started, but that the custom in the district is for the quiet inauguration of new activities by a few associated persons who put in their own capital, run their properties without ostentation and own them in their entirety rather than organize companies and develop the properties with capital obtained by disposing of interests. A mine promoter would be a real curiosity on the streets of Leadville. This remark is not intended as any criticism of the practice of promotion as it pertains to most mining districts, the point being made simply to show this interesting fact about Leadville's career.

People, therefore, do not lose money in Leadville listed stocks. Quite true, money has often been sunk in unprofitable ventures in the district. When a new mining project is contemplated, a resident puts his own money into it—if he has it. If he cannot handle the situation alone, he quietly interests outside parties who visit the district. Such persons, being satisfied with the proposition made to them and their engineer's report proving affirmative, promotion is accomplished, and frequently even the newspapers are unable to ascertain the identity of the new investors. In other words, capital is usually introduced into Leadville projects not in the way of speculation but as investment.

Where is there another mining region in the world that has operated continuously for 56 years and can boast of the many metals that issue from Leadville's mines? The mineralization of this area is another unique feature. Leadville produces, commercially, gold, silver, copper, lead, zinc, iron and manganese; while it has deposits carrying bismuth, molybdenum and tungsten, some of which have at times been worked, though mainly as side issues.

The first discoveries were of placer gold by prospectors en route to the California gold fields. From the beginning trouble was experienced with a heavy rock that clogged the riffles of the primitive sluices, but its identification as the carbonate of lead carrying silver was not made until 1874. Meanwhile, in 1868, the first gold vein was opened and the first stamp-mill was built. In 1875 the first smeltery was built to treat the gold and the lead-silver ores that had by that time been extensively proved. From that time on the growth of the district's population and activities was rapid; but there was no

town called Leadville until 1877, when a petition from citizens resulted in the establishment of a post office. The name Leadville was selected only after a consideration of such names as Cerussite, Agassiz and Lead City. In 1880 the town had 28 mi. of streets (partly lighted by gas), more than 5 mi. of city water pipes, 14 smelteries and 13 schools. In 1886 S. F. Emmons, of the United States Geological Survey, estimated the area of the then producing section as approximately one square mile. Since then the known mineralized territory has been much extended, although it is now far from thoroughly developed or even prospected.

The geology of the area is not particularly complex in its essentials, but the existence of numerous strong faults has rendered following the measures somewhat difficult. Briefly stated, the formations consist of great beds of limestone lying upon Archæan granite and alternating with smaller beds of quartzite, all these sedimentaries being more or less intruded by porphyries. The argentiferous lead ores are found as replacement masses in the limestones, while the gold and copper ores are generally in the siliceous rocks—porphyry and quartzite. Whereas the typical orebodies of the district are irregularly shaped and irregularly spaced masses in the sedimentaries, there are also typical veins and these are, in fact, the principal carriers of gold.

For many years past this district has produced great quantities of silver-bearing iron-manganese ore that is sought by the Colorado smelters for its excellent fluxing qualities. This sort of ore occurs in much the same manner as does the lead-silver ore and is the oxide of iron and manganese.

In the operation of many mines certain heavy brownish and yellowish rocks were encountered abundantly associated with orebodies in limestone. These were carefully avoided as being nothing more than worthless gangue or country rock until about ten years ago, when they were identified as the carbonate and silicate of zinc. A new impetus was then given to mining here; abandoned mines in which these minerals were previously avoided were reopened and zinc mining became a new industry.

None of the numerous early-day smelteries remain. These plants served well in their time. Today Leadville has the splendid modern Arkansas Valley plant of the American Smelting and Refining Co. and a locally owned smeltery to treat the nonsulphide zinc ores of the district. Cyanidation was introduced in the late '90's, but it did not prove succesful with the gold ores of the district, applied, as it was, only as a leaching process. Most of the ores, especially the sulphides, are smelted without preliminary dressing, but they could well be concentrated if shipment to distant smelting points was necessary. Electrostatic separation has been practiced for years in one large mill, while flotation, following tabling, is in successful use in another, but relatively new plant. The district offers splendid opportunities in the adoption of uptodate modern methods of concentration.

Mining at Leadville was never carried to any considerable depths because of heavy flows of water. There are known to be large quantities of ore in all the old mines, below water levels. Two years ago a leading operator entered into arrangements with the owners of surrounding properties whereby he was able to enlist capital and to organize a pumping company that has just succeeded in unwatering an area partly within the city limits and termed the Downtown district. During the past winter a corporation with large mining and smelting interests throughout the country secured control of another group of properties and installed a second important pumping plant that is now accomplishing its purpose. A single company, encouraged by the success of these two enterprises, has recently undertaken, with new equipment, to drain its property to new depths. These deep-drainage projects have thus taken a strong hold in the district, and various companies are contemplating similar work. Already numerous old mines in the previously flooded portions of the district, but now unwatered by the pumping operations, are being reopened, and the immediate future for the district is bright indeed.

Up to the present time the greatest activities have been in the hills immedately east of the city. The geological series in these hills extends considerable distances to the east, north and south, and there are great virgin areas with just as attractive possibilities awaiting the prospector and capitalist. The typical Leadville formations described terminate a short distance west of the city along the bed of the headwaters of the Arkansas River, which here flows south. West of this river the region consists of granite comprising the Sawatch Range or Continental Divide. This area, closely tributary to Leadville, is traversed with porphyry dikes and sheets and with fissures that have been but little explored, but in which a few noteworthy orebodies have been profitably exploited. This area, too, extends possibilities to persons possessing the means to explore and develop.

It cannot be denied that Leadville has been rather dull for a few years past, but at present the district seems to be on the eve of a most important period of prosperity. There is not an able-bodied miner in the district idle. In fact, men are all too scarce. Therefore we come back to the question at the head of this article, and we conclude that Leadville, with her wonderful resources of base, semi-precious and noble metals, can be described by saying in "modern classical" language, "She's all right."

Gold Mining in Chile

By Mark R. Lamb*

There are five small stamp-mill and cyanide plants in Chile treating gold and silver, but all are on a very small scale, the largest having a capacity of 30 to 40 tons daily. There are two Tremain stamps and three gravity batteries, but the total capacity is insignificant—except to the owners. The most attractive, perhaps, is the "Mina Miles," which at present is treating 3-oz. ore. The ore is free-milling, though the little plant includes a table and some leaching tanks. The concentrates are shipped to Europe, 9 to 10% of the content paying all charges.

All the small mines are Chilean owned. The capital and energy required for carrying the venture through is supplied by local capitalists. The Chilean is always ready for a venture in mining and is a thorough sportsman, taking his losses or gains coolly and is always ready for the next venture. He pays for what he buys and insists upon having the best. In questions of technical assistance he is just as ready to pay. I am only sorry there are not thirty million instead of three million Chileans.

*Allis-Chalmers Mfg. Co., Santiago, Chile.

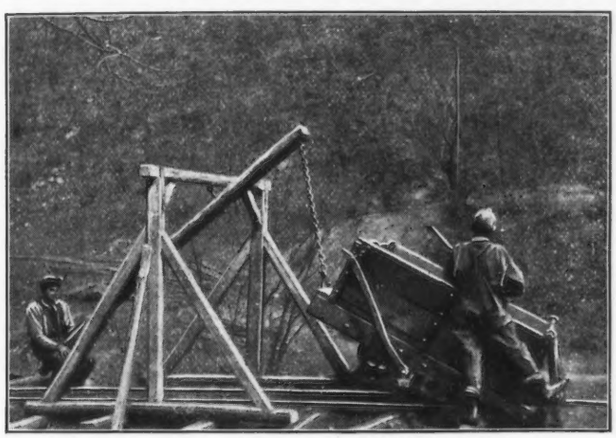
Details of Practical Mining

Device for Dumping Waste Cars

By Roy S. Bonsib*

Dumping waste is an important factor in the cost of mining, especially when doing a lot of "dead work" or underground development. Any device which will lessen the cost of this operation is therefore worthy of consideration and installation if possible.

The apparatus shown was made up on the property and has given entire satisfaction, having reduced the time of unloading about one-half, to say nothing of a material saving in labor. Before its installation two men and two boys were required to dump the car



A DEVICE FOR DUMPING WASTE CARS

(1¼-ton capacity); now two boys do the work with the expenditure of little effort. This type of crab, as it is called, may be pushed along on the ties as the dump pile advances, without trouble or any great loss of time.

Timber hewn on two sides, such as is used for mine ties, forms the framework of the crab, which is held together by 40-d. nails and two- iron straps. These straps, chain and eye-bolts used on the lever, were taken from the scrap pile, and their cost may, therefore, be neglected. The cost of this crab figures up as follows: 58 ft. timber @ 1½c. per ft., $0.87; 4 lb. 40-d. nails @ 2c. per lb., $0.08; 7.5 hr. labor @ 17½c. per hr., $1.30; total, $2.25.

Finding the Tension in a Cableway Rope

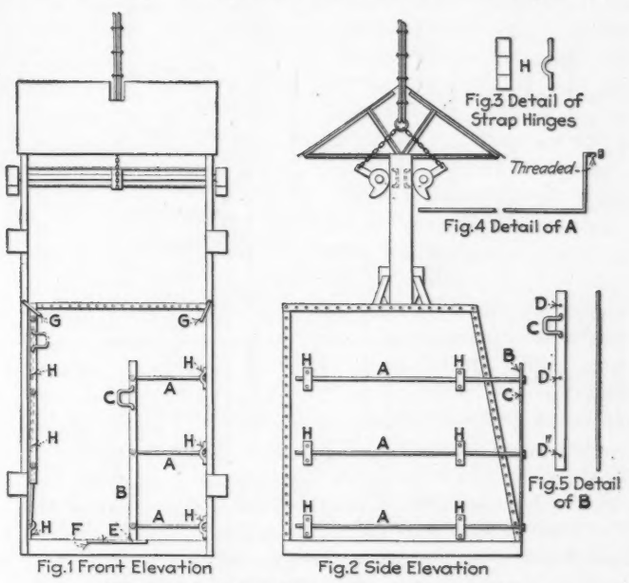
A cableway rope should be chosen so that there will be a factor of safety of 4 when the maximum load at the center of the span is producing a deflection equal to 5% of the distance between supports, says *Leschen's Hercules.* This deflection should then be maintained, and to this end the rope should be pulled in or out as the temperature rises or falls during the course of the year.

To find the tension in a cableway rope, the following simple method is very convenient: For a deflection equal to 5% of the span (the load being at the center of the span) the tension in the rope is equal to 5 times the load added to 2½ times the weight of the suspended rope.

Folding Safety Gate for Cages

The safety gate shown by the accompanying sketch is used on all cages at the Esperanza and Pilares shafts of the Moctezuma Copper Co.'s mine at Pilares de Nacozari, Sonora, Mexico. The gate consists of few parts and is of extremely simple design. It fully accomplishes the purpose of a cage gate, yet has the advantage of folding back against the sides of the cage completely out of the way when supplies and materials are being loaded.

The cages at Pilares are of the standard all-steel design, and while employed to some extent for raising ore in cars, they are used principally for the transportation of men and supplies required in the mine. The cages have



FOLDING SAFETY GATE FOR CAGES

a single deck just large enough for one steel mine car of the usual 20-in. gage, end-dumping type. The back and two sides of the cages are covered by steel plates bolted to the frame extending above the cage floor to a height of 4½ ft.

Each half of the safety gate is bolted by iron straps, detailed in Fig. 4, to the steel siding of the cage. The bent bars *A*, of which there are three for each side of the gate, are made of ¾- or 1-in. round stock 4 in. less in length than the side length of the cage plus one-half the front width. Each bar is bent at right-angles at a distance from one end equal to 4 in. less than half the width of the cage, and again at a distance

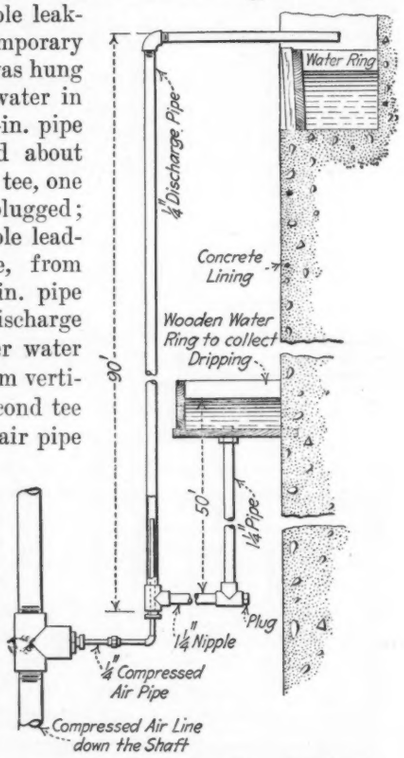
*Mining Engineer, Low Moor Iron Co., Low Moor, Va.

of 2 in. from the same end, so that the bar has the form shown in Fig. 3. The short right-angle bend is threaded to receive a nut. The other member making up the rest of half the gate, detailed in Fig. 5, is a straight bar of steel *B* ⅜x2 in., 4 or 4½ ft. long, with a handle *C* riveted or bolted to it at a convenient height, and with three holes *D* for the side bars, which are bolted in as shown in the illustration. Fig. 1 shows one side of the gate folded back against the side of the cage, and the other side let down into position, the lower end of the bar *B* dropping into a rectangular slot *E* in the floor of the cage, a small steel plate *F*, suitably slotted, being attached to the wooden floor of the cage to act as a catch or guide for the bar *B*. In the folded back position the gate is held by the keep *G*.

An Air-Lift for Auxiliary Unwatering

The accompanying illustration shows the method of water collection and removal used recently in a shaft-sinking operation in Pennsylvania, according to *Coal Age*.

The shaft was provided with a water ring, from which there was considerable leakage, so a second temporary wooden water ring was hung 40 ft. lower. The water in it drains into a 1¼-in. pipe extending downward about 50 ft. vertically to a tee, one branch of which is plugged; the other has a nipple leading to another tee, from which another 1¼-in. pipe leads up so as to discharge water into the upper water ring. Into the bottom vertical branch of the second tee a ¼-in. compressed-air pipe enters and rises about 18 in. into the water-discharge line. This air lift elevates the water collected in the secondary ring to the first ring, from which it is pumped to the surface by the main units. The use of air lifts for auxiliary unwatering in shaft-sinking operations seems to be increasing. It is a flexible installation and more easily extended than sinking pumps, with their water, steam and exhaust lines. Even if operated by compressed air a sinking pump is more cumbersome than an air-lift.

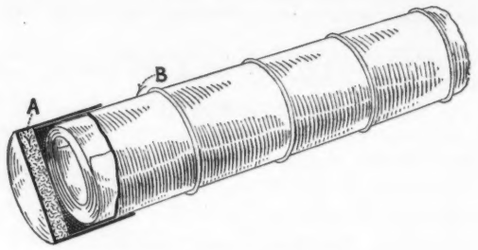


ARRANGEMENT FOR EJECTING WATER FROM THE LOWER WATER RING

A Drilling Contest between a single-jacker and a jackhamer arranged by Louis A. Rehfuss, West Point, Calaveras County, Calif., resulted in the jackhamer, with air at 60 lb., drilling 81 in., while the hammersman drilled 9 in. The cost per jackhamer shift figured out 1.75 times that of the hand-drilling shift, but the cost per foot of hole drilled by the jackhamer figured only 19½% of the cost of hand-drilled hole.

An Improved Blueprint Tube

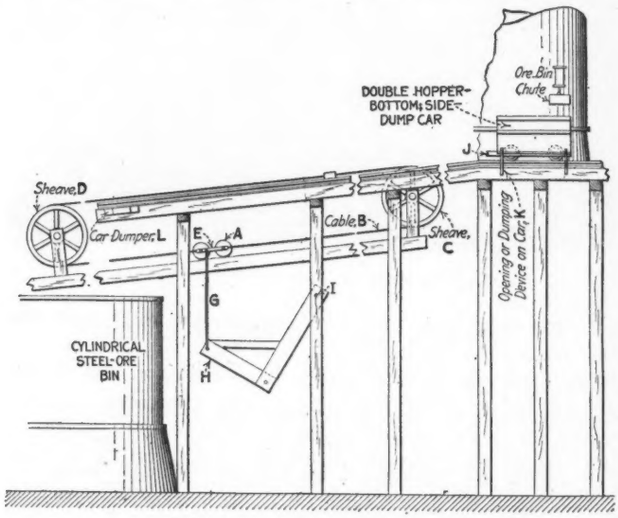
If the cover of the cylindrical container for blueprints does not fit tightly, the prints are subject to dampness and the attendant deterioration. The following arrangement to remove this fault was shown recently in the *American Machinist*. A felt wheel *A*, about ¾ in. thick was turned down to the right size and then shellacked to the inside of the cover. The tube *B* now hits the felt, making a good joint. No trouble is experienced in keeping blueprints in good condition by the use of this device.



A TIGHT BLUEPRINT TUBE

Automatic Car Return

At the Belmont shaft of the Tonopah-Belmont company at Tonopah, Nev., the ore is raised in skips that dump into a small bin in the headframe, from which it is conveyed in a car over an inclined trestle to the cylindrical steel ore bins at the crusher house. The work of the descending loaded car is utilized to trip automatically the doors, thus dumping the load, and to return the empty car to the front of the ore bins at high speed.



AUTOMATIC CAR-RETURN DEVICE

The working of the scheme is readily comprehended through a study of the accompanying sketch. The track is supported on stringers carried by bents, and from a point just beyond the front of the ore bin the trestle is on a fairly steep grade. Immediately in front of the bins the track is level or nearly so. Some way down the track, a sheave *C* is supported below the track-carrying stringers, while still farther below and beyond the second ore bin, not shown in the sketch, is another sheave *D*, over which a cable passes, running between the rails. Below, the cable runs from the sheaves to the correspond-

ing end of a two-wheeled trolley *E* running on a short track below the car track. Attached to the cable between the car tracks so that it lies on and across the track is a bar *F*.

From the trolley *E* hangs a double suspension rod *G* connected to one end of the heavy timber structure *H*, which is pivotally mounted on one of the bents at *I*. The structure *H* is so built as to carry a load of rock, a concrete block or other suitable weight. The ore car is of the double hopper-bottom type with trippers *K* for opening the side doors. The car is provided with a bumper *J* between the front wheels.

The loaded car is pushed a few feet to the edge of the incline, thence it descends rapidly and with increasing momentum, the bumper *J* engaging the crossbar *F*, moving it in the direction of the lower sheave *D*, with the result that, being attached to the cable, the trolley *E* is moved from its position *A* to *B*, lifting the weight *H* thereby about the pivotal point *I*. At the same time the tripper *L* on the track-carrying stringers engages the catches *K* on the car, causing it to dump its load. Thereupon the weight *H* drops back, moving the trolley *E* back to its position *A*, causing the cable with its crossbar *F* to move to its former position, all being done so quickly that the crossbar in engaging the bumper *J* strikes it with such force that the car is returned at high speed to its position in front of the headframe bins. The sketch shows the principle.

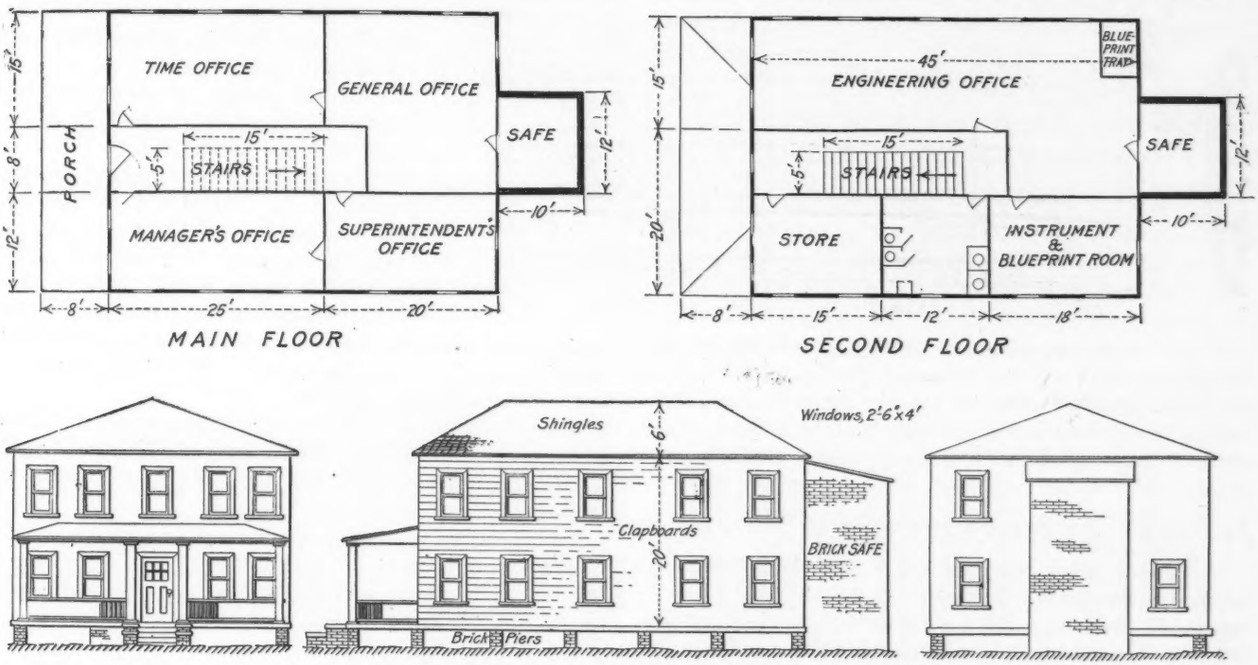
Du Pont Products is the title of an interesting booklet published by E. I. du Pont de Nemours & Co., Wilmington, Del., which will be a surprise to those who believe that the Du Pont company manufactures solely explosives. This booklet lists and describes 251 distinct commodities manufactured and sold by this company, which, besides covering the entire field of explosives, contains also other commodities ranging from the transparent material used in auto curtains to the near-ivory used in jewel boxes and toilet articles and the imitation leather with which many automobiles are now upholstered. It is not only a most interesting and instructive little booklet, but a handy compendium of information relating to the 251 commercial products covering a wide range of general business.

Mine-Plant Office

The following is the design and specification for a mine-plant office recently constructed. This building housed comfortably the operating office, engineering office and time office for a property employing about 600 men.

The building itself is of two-story frame construction, 35x45 ft., set on brick piers. A brick vault 10x12 ft., having iron doors opening into the main office on the first floor and the engineer's office on the second, is for the protection of the records from fire and theft. The outside is covered with clapboard, the roof shingled and painted all over. The inside is ceiled throughout with No. 2 grade tongue-and-groove ceiling. All rooms are electrically lighted and steam-heated. The function of each room is self-explanatory.

The sills are 6x8-in. rough timbers; first-floor joists, 2x 10-in. S 4 S; second-floor joists, 2x8-in. S 4 S; studs, 2x6-in. S 4 S; partition studs, 2x4-in. S 4 S; rafters, 2x6-in. rough; doors, 2 ft. 6 in. by 6 ft. 6 in.; windows, 2 ft. 8 in. by 4 ft.



PLANS AND ELEVATIONS OF MINING COMPANY OFFICE

It was found by actual tests that sized lumber for framing is more economical than rough, as the additional cost for material is more than offset by the extra time required to fur and dress the rough framing to get it in condition for ceiling.

A building of this type costs in the neighborhood of $2,000 to $2,500, depending on local conditions. If the structure is to be reduced or enlarged, the approximate cost can be figured by allowing $1.25 per square foot of dimensions and applying this positively or negatively to $2,500, as the case may require.

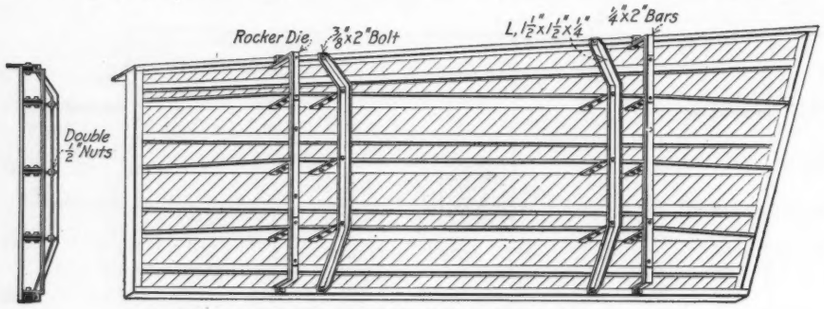
If built in the tropics it is well to screen the windows and porch and place inverted dishpans on the piers under the sills to reduce the possibility of insects in the office. If built in the north it is well to board in the spaces between the piers to assist in keeping the office warm. A layer of building paper under floors and behind walls is also advisable.

Details of Milling and Smelting

Repairing Wilfley-Table Decks

W. L. ZEIGLER*

After No. 5 Wilfley tables have been in operation a number of years, the first serious weakness usually appears in the supporting trusses, causing the deck to have an unsteady motion and affecting the separation of the ore. To replace the original trusses necessitates practically the complete rebuilding of the deck. The method illustrated was used to repair 10 decks, and all have been in constant operation for three years, none having shown



METHOD OF REPAIRING CONCENTRATOR DECKS

the least weakness. This is a rapid and inexpensive manner of replacing the trusses, and the tables show a wonderful stability even on a shaky table floor. If the surface has become warped, it may readily be drawn back to the original plane with the supporting angle trusses.

James' Refractory-Ore Process

William Holman James, of the Village Main Reef gold mine, Johannesburg, Transvaal, South Africa, has patented (U. S. Pat. 1,184,456, assigned to the New Refractory Ores, Ltd., of Johannesburg) certain electrochemical treatment of refractory ores prior to cyanidation. The process contemplates treating refractory precious-metal ore with a solution withdrawn from the vicinity of an anode in an electrolytic vat containing a solution of sodium chloride, or other salt of a mineral acid. (The solution may be drawn from either electrode but preferably from the anode.)

The refractory constituents are supposed to be dissolved and removed with the solution, after which the ore is assumed to be amenable to the ordinary cyanide process for extraction of the precious metal. The electrolyzed liquid is stated to have a preferential action on the refractory substances, and practically no precious metal is dissolved so long as refractory substances are present. Certain of these such as graphite, though not dissolved, are said to be liberated from the ore upon the dissolution of the other refractory substances, and are to be recovered in any suitable manner; for instance, graphite may float to the surface of the liquid and be skimmed off. In case arsenic is the principal refractory constituent, it is said to be preferable to use an alkaline cathode product in place of the acid electrolytic product. It suggested that the refractory-metal constituents, after having gone into solution, may be recovered by treating the solution in any appropriate manner.

*Mill superintendent, Success Mining Co., Wallace, Idaho.

Improvements at East Helena Smelting Plant

Among the improvements in 1915 at the East Helena smelting plant of the American Smelting and Refining Co., the following are enumerated by retiring president M. H. Gerry, Jr., of the Montana Society of Engineers, in his annual address:

The construction of large natural-draft ventilating hoods and stacks in front of blast furnaces Nos. 1 and 2, completing the work started in the previous year. These are for the purpose of carrying off the smoke arising from the tapping of slag and matte from the furnaces and forehearths.

The rebuilding and enlarging of the crucibles of blast furnaces Nos. 1 and 2, increasing the effective length of the furnaces by 26 in. and their capacity by approximately 15%.

The rebuilding and enlarging of the crucibles of blast furnaces Nos. 1 and 2, increasing the effective length of the furnaces by 26 in. and their capacity by approximately 15%.

The installation of a lead-molding or casting-machine in the drossing plant for handling lead bullion was also noted. The lead bullion from the blast furnaces is dumped into 50-ton drossing kettles, and after skimming off the dross, the bullion is drawn into a pouring ladle that discharges intermittently into molds holding about 100 lb. each, mounted on an endless chain. The bullion is automatically molded, stamped with a lot number and discharged from the end of the machine on the loading trucks.

In connection with welfare matters a considerable sum of money was spent in guarding machinery and other safety measures recommended by the general safety committee and the workmen's safety committee. A modern changehouse was constructed of hollow tile and brick with steel roof trusses and asbestos-shingled roof. This changehouse is equipped with 500 sanitary steel lockers, wash sinks and shower baths for the use of all employees. In this building is the office of the plant physician, who spends 2 hr. at the plant each day. The doctor's office is furnished with modern equipment, a supply of medicines, bandages and first-aid apparatus. There were also installed washrooms and lunchrooms in various parts of the plant. This should be an important factor in preventing "leading" of workmen, as it encourages the practice of washing the hands before eating.

The Cost of Doing Things

Douglas Island Wage Rates

The following is the wage scale now prevailing at the Alaska Treadwell, Alaska United and Alaska Mexican mines at Douglas Island, Alaska:

Machine drillers	$3.50 per day
Machine helpers	3.25 per day
Mine laborers	3.00 per day
Amalgamators	$120.00 per month
Feeders	100.00 per month
Vannermen	$95 to $130 per month
Machinists	$3 to $7 per day
Blacksmiths	$5 to $6 per day
Tool sharpeners	$4.50 per day
Blacksmiths' helpers	3.00 per day

Employees who board at the company's boarding house pay $25 per month for meals and $2 for a room. The average number of men employed per day for the year by Alaska Treadwell was 718 and the average wage paid was $3.61. The Alaska United employed 276 men at $3.46 and Alaska Mexican 121.24 at $3.36.

Brunswick Consolidated Costs

The ore production from the Brunswick Consolidated Gold Mining Co., Grass Valley, Calif., for the year 1915 was 22,004 tons. The average mill head was $11.113 per ton, of which $8.887 was recovered in bullion and $1.201

STAMP-MILL DATA FROM THE BRUNSWICK MILL

	Tonnage	Stamp Hours Run	Stamp Tons per Hour	Duty Tons per Day	Stamp Hours Lost	Oz. Quicksilver Fed to Batteries	Value Bullion Recovered per Oz. Quick Fed
New mill....	3,728	29,840	0.1249	2.988	5,200	1,625	$12.373
Old mill.....	18,276	167,610	0.1090	2.616	7,590	10,421	16.988
Totals ...	22,004	197,450	0.114	2.673	12,790	12,046	$16.365

DETAILS OF OPERATING COSTS PER TON

	Per Ton
General	
Administration, salaries	$0.3238
New York and San Francisco offices	.0912
Traveling expense	.0259
Mine expense account	.1125
Taxes	.1512
Fire insurance	.0297
Casualty insurance	.1267
	$0.8610
Mining	
Labor	$2.8374
Supplies	1.0270
Power	.8572
Pump labor	.1643
Pump supplies	.0428
General repairs	.0130
Tribute labor	.0014
Tribute percentage	.0226
	$4.9657
Milling	
Labor	$0.2997
Supplies	.0480
Power	.1736
Bullion freight and refining charges	.0299
Concentrates freight and treatment	.2878
	$0.8390
New Shaft	
Labor	$0.0334
Supplies	.0106
Power	.0034
	$0.0474
Repair Accounts	
Mill repairs, labor	$0.0095
Mill repairs, supplies	.0617
	.0017
	$0.0729
Improvements	
Mine telephone installation	$0.0005
Mine equipment	.2922
New road, labor	.0011
New shaft headframe, labor	.0813
New shaft headframe supplies	$0.1857
New mill construction, labor	.4132
New mill construction, supplies	.7838
New dry construction, labor	.0077
New dry construction, supplies	.0164
New shaft spur track station, labor	.0118
New shaft spur track station, supplies	.0128
	$1.8065
Total mining and milling cost, per ton	$8.5925

in concentrates, making a total recovery of $10.088, indicating a tailings loss of $1.1025. Total mill extraction was 90.08%, of which 80% was recovered in bullion and 10.08% in concentrates. There was a total of 375 tons of concentrates of an average value of $70.31 on which the cost of freight, refining and loss in treatment was $17.12 per ton.

Comparative Cost of Distillate

In a series of tests on pumping water with internal-combustion engines, C. R. Knowles, general foreman of water works, Illinois Central R.R., in an article in *Engineering and Contracting,* states that he found that distillate is the most economical of the low-grade oil fuels. The cost per water horsepower for pumping was 53% of the cost of pumping with kerosene and 27% of the cost of pumping with gasoline. In pumping against a total head of 61 ft., with an 8x10-in. single-cylinder double-acting pump direct-connected to a 6-hp. 4-cycle horizontal gasoline engine using distillate, the cost per 1,000 gal. was $0.0033; using alcohol, $0.0327; using kerosene, $0.0056; using gasoline, $0.0124; using motor spirits, $0.0092. The consumption per hour in pints with the different fuels enumerated was as follows: Distillate, 6; alcohol, 7; kerosene, 6; gasoline, 7; motor spirits, 6.

With a 12-hp. 4-cycle gasoline engine with a hit-and-miss governor, pulling a 7½x30-in. working barrel in a deep well, the cost of pumping per 100 gal. of water, using gasoline fuel was $0.029; using distillate, $0.0108.

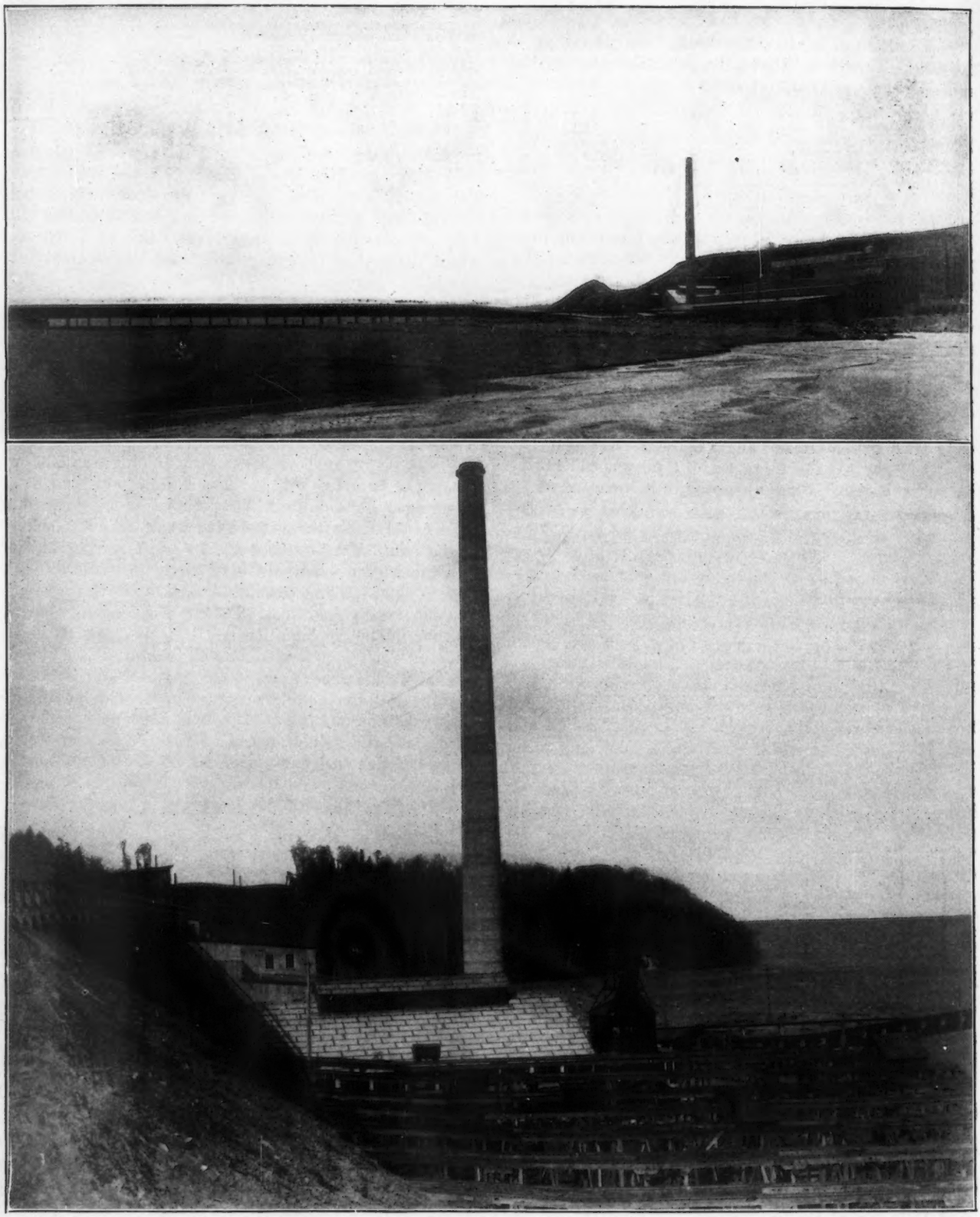
Boiler Cleaning Costs

The cost of cleaning a boiler is given in *Power* of May 23, 1916, by Harry A. Cox, who says that although certain variables enter into the problem, such as the character and thickness of scale, these can be taken into account and comparison made on the basis of the cost per tube. The boiler in this case is a B. & W. operated at 200 lb. pressure and was cleaned with a water turbine.

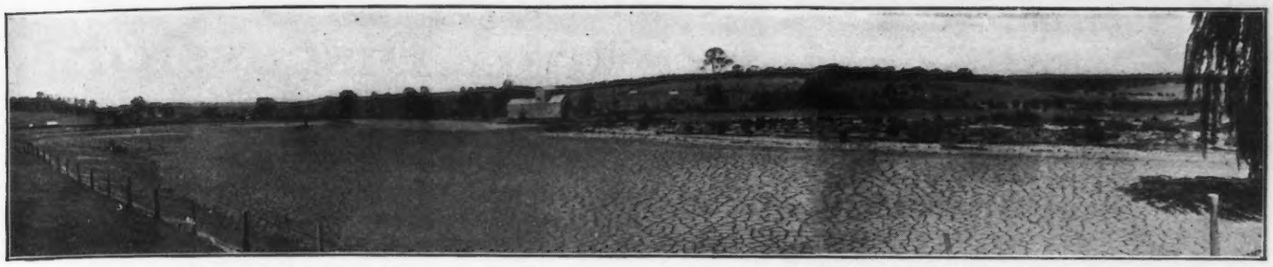
Size of tubes, in.	4
Number of tubes	287
Boring time, hr.	13½
Approximate thickness of scale, in.	⅛
Cost Data:	
Cutter wheels	$3.00
Water, 9,000 cu.ft., $0.18 per 1,000	1.62
Labor	8.78
Steam, 4,942 lb., $0.125 per 1,000	.62
Oil	.60
Total	$14.62
Cost per tube	$0.051

The number of pounds of steam is figured on displacement, with 10% allowed for condensation losses, from the number of strokes taken to clean each tube, the pump being operated on full boiler pressure.

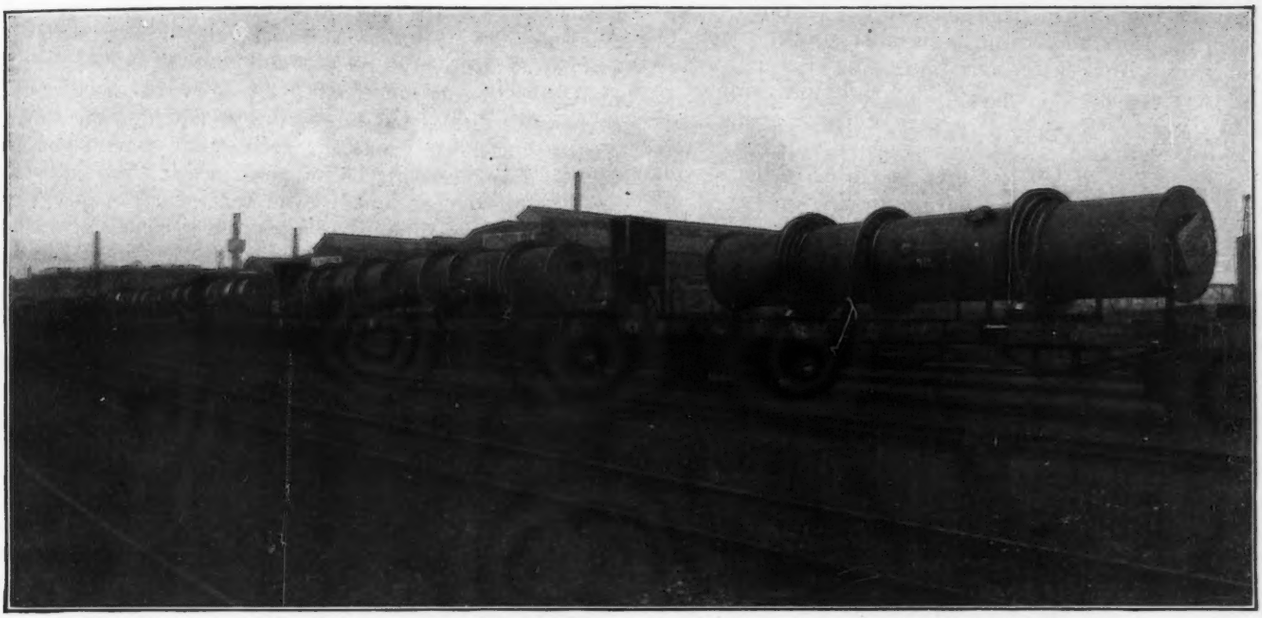
Photographs from the Field



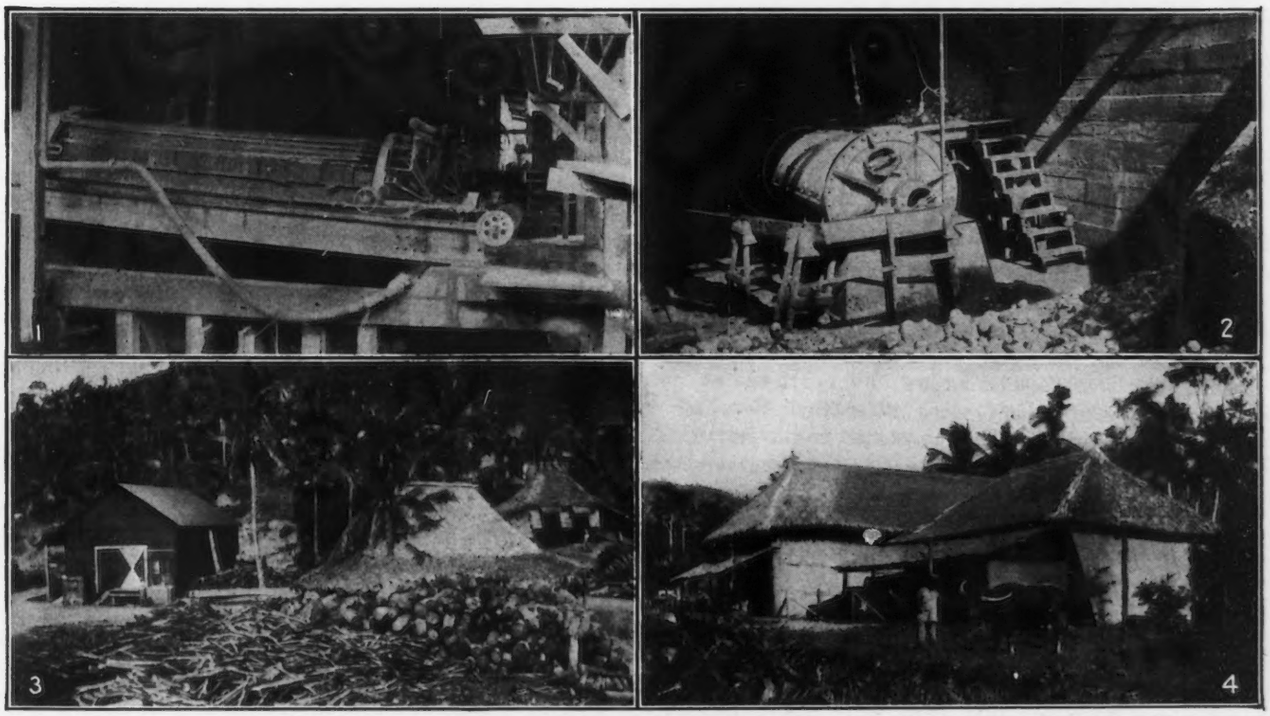
THE BALTIC MILL, NEAR RED RIDGE, AND CONCRETE SMOKESTACK AND COAL DOCKS AT RED RIDGE, MICH.



CAMPBELL'S CREEK, CASTLEMAINE, VICTORIA, AUSTRALIA. DREDGED LAND BEING RECLAIMED FOR AGRICULTURAL PURPOSES



LEACHING DRUMS FOR CHUQUICAMATA AT THE FACTORY AT COLOGNE, GERMANY



1—KELLY FILTER AT SYNDICATE MILL. 2—TUBE MILL AT COLORADO PLANT. 3—LANDING OF COLORADO MINE. 4—THE VILLAGE DANCE HALL AND AMUSEMENT PALACE. ALL IN THE AROROY MINING DISTRICT, MASBATE, P. I.

Correspondence and Discussion

Power for Slimes Agitators

In operating two types of slimes agitators in flat-bottomed tanks 30 ft. in diameter and 10 ft. deep, it is found that there is a great difference in power required. Two tanks in which are placed four stirring arms on a vertical shaft making 8 r.p.m., consumed 10 hp. A third tank in which the Dorr mechanism is installed uses but 2.02 hp. and gives a little better agitation. The stirring arms of the Dorr are run 2.7 r.p.m. This speed, in conjunction with the air lift, which is a part of the machine, gives excellent agitation. The Dorr machine requires 1.8 hp. to operate the air lift and 0.22 hp. to drive the moving parts. The slime charges have a specific gravity of 1.2 to 1.5.

An article appeared in the *Journal* of May 6, 1916, describing the Devereux agitator. According to the writer this agitator used 10 hp. and was working on material of about the same specific gravity as the agitators just described and in a tank of essentially the same size.

L. S. Harner,
Mill Superintendent,
Golden Cycle Mining and Reduction Co.
Colorado Springs, June 6, 1916.

Experience of a Prospector in Honduras

All writers of repute tell us to search for the truth, and with this object in view I give the following facts with the hope that they may be of service to some tenderfoot who may try prospecting in this country. Having read of the rich mineral wealth of Honduras I thought it would be worth a trial.

On arriving in the country, with a stock of the Spanish language, about enough to keep me out of jail and from starving; found the people kind and accommodating, friendly to the gringo when there is any chance to get any money out of him, naturally suspicious, excitable and emotional, the common man a good and faithful worker. The office-holding class, of which there is an ungodly lot, are as a rule grafters from Graftersville and they can't help it, as the majority of salaries is not enough to keep a cat alive. Besides he has to support one or more sweethearts; they always look after their love affairs first, business can wait, but the woman might get away.

I had no knowledge of rocks, geology, mining, minerals, or prospecting, but hoped to get started right by purchasing a copy of the Mining Code, cost two pesos, and then got it translated enough to get the sense of it, cost another 25 pesos, and came to the conclusion that Honduras is evidently in love with the miner, as the code gives him about half the country with a six-strand wire fence around it; but I found out later that there is a vast difference between mines and prospects, also that there are several laws since the Code that trim it of many privileges.

Not knowing anything about prospecting, I thought it would be best to grubstake an old hand at the game, which I did, and sent him out. He came back in ten days with a pocketful of rocks, some of which looked to me like a cross between chalk and dry bone, but he had a report from an assayer friend of his that he could recommend as an honest man and had fifteen years' experience in the business; the assays ran away up in the blue sky, free gold and sulphides. My man had spent all the money that I had given him, 100 pesos, and wanted more to go and make the denouncement. I told him I thought the assay to be a fake, but to convince him that I was not a quitter but in the game for keeps, gave him 200 more for the denouncement; he returned in a few days, busted again, said the lawyers, interpreters, stamp paper and hotel got the dough, but had a paper that called for a hole to be sunk 30 ft. deep in the next 90 days. In order to do this work, had to order drills, hammers, picks, shovels, from New Orleans, as none could be found in any of the stores. They arrived 35 days later and cost 97 pesos, as I had to pay duty on them, yet the Mining Code said free importation for mines. I thought the duty could be arranged and went to the Governor of the Province, and he wrote a telegram to the Minister of Fomento, in Tegucigalpa, explaining the situation and asked for free importation of the tools and for dynamite to do the work. This wire cost me 2.65 pesos and now after 13 months have never received any answer to it. The Government sells black powder, but only one pound to one person per day. The prospect was 12 mi. from the powder station and the cost of hiring men to go after it each day made it 10 pesos per pound.

The Mining Code gives the right for one mine to loan another mine dynamite; but I had no mine, only a prospect; the result was I could not borrow a stick from any one; I succeeded in buying 25 ft. of fuse from one man, and six caps from a Carrib that he had smuggled into the country to kill fish and got a friend to steal six sticks of powder from the railroad company; otherwise I never would have been able to sink the legal requirement hole. In the meantime I had sent the first samples to the States for assay which took 40 days and they were nothing like the old honest leg-pulling artist but enough to warrant investigation. Now my 90 days about out, I went to the Judge to take out the provisional title. The Judge told me that I must have a lawyer to make the petition on stamp paper, cost 25 pesos; and the lawyer told me there would be no charge in the Judge's office—simply present the petition to the Judge and he would order his secretary to make the title.

On the door of the Judge's office was posted the notice—Office hours 8 to 11 a.m. and 2 to 4 p.m. The Judge did not come in until 10:30 a.m., when I presented my petition and he told me that he was very busy and to come back at 2 p.m. His secretary and two other men had been very busy all the time reading a newspaper, talking politics and about their love scrapes. I returned at 2 p.m. and the Judge came in at 3:15 and told me if I were in a hurry that he would do me a favor by ordering his

secretary to make the paper after office hours, which he did at a cost of 15 pesos for extra work. Apparently my troubles have just begun. Recently telegraphed the Minister of Fomento for permit to import dynamite to work in the mine; he answered when a mine has concession the law gives free importation, yet my application has been in his office since last August pending his decision. No need for more details, the above shows how the game works. Honduran officials claim that the mines are not worked, yet when a man tries to do anything he can't do it. I have kept an accurate account of every cent spent on this prospect and it stands now 1,102.33 pesos and it looks as if it will cost as much more before the definite title is granted, if it is ever done. My advice to all prospectors, especially the tenderfoot kind, is to stay out of Honduras until you have money enough to buy an established mine and to the old-time prospector be prepared to do your own assaying and sink the legal prospect hole with your fingers and a jackknife.

I know of other promising prospects but they can't be handled under present conditions, the cost is prohibitive. None but the rich need apply and they have no use for a mine. The poet in truth has said:

I started out to be honest,
With everything on the square,
But a man can't fool with the golden rule
In a crowd that don't play fair.

Hoping that others may have better luck than I have and if you don't believe this tale of woe, then come and try it yourself.

THE TENDERFOOT,
QUIEN SABE.

Roatan, Honduras, May 22, 1916.

"Conversational Geology" at Oatman, Ariz.

Under the stress of strong emotion, I rise to remark: To start with, I shall have to disqualify myself as an expert" witness; unfortunately I am not a geologist, and what I know about the subject is only what the rough-and-ready mining engineer picks up by the hard knocks of everyday life. So, to the brethren of that field of endeavor, my testimony will be thrown out on the face of it. However, in my own defense, let me state that during the last 2½ years it has been my good fortune to have all the developments of this district open to my inspection and to have the privilege of hearing the ideas of men far higher in the mining field than myself. If my opinion is worth anything, it is due entirely to the advantages which have been so kindly thrown in my way.

Under the head of "careful observation," a rehash of old reports and Government bulletins has been handed out to the public by writers on the Oatman district, until it would seem that the authors of those original publications must live in one long hideous nightmare.

Mr. Schrader seems to have started the ball rolling when he described a green chloritic andesite, an older andesite, and adularia in connection with this district—possibly a few other things in the rock line, too, but those are the favorites among the present-day writers. Mr. Schrader is a man for whom I have the greatest respect. Under the conditions of his visit to this country he had but a short time to spend in this immediate district, and at that time there were practically no developments in the district of any note. His conclusions are well drawn when one considers the developments then.

If the "conversational geologists" would confine themselves to the statements actually made by Mr. Schrader, they would not go far astray. But when they make observations by traveling in or out of the camp by automobile and without ever having gone through a real mine in the district, they come out with statements which, to say the least, are slightly misleading—and Mr. Schrader gets the blame but not the credit.

To start with, there is not a positively known instance, with one exception, where the valuable oreshoots do not come at least within 100 ft. of surface. The Gold Road mine has stoped to surface and so has the Tom Reed. Out of four oreshoots in the district personally known to me, two come to surface with commercial ore, one has been proved within 100 ft. of the surface and may come higher; the fourth is the exception and only came to the 250-ft. level. No other oreshoots in the district have been proved enough to know how close to surface they extend. There is undoubtedly a capping over some of the important veins in the district, and we would hardly expect to find the ore coming through this capping, but its very occurrence seems to have slipped over the heads of the writer artists.

Why all the worry about "green chloritic andesites" and "older andesites" and whether there is any ore in one or the other? I will defy any man alive to prove the difference in the field. But then they do sound nice in a report. Perhaps my eye is not sufficiently bright, but I prefer to depend on microscopic examinations of thin sections for my classification rather than hand specimens. Mr. Schrader uses the terms and that seems to be sufficient for most of the writers. However, Mr. Schrader also says[1], "So far as learned the old andesite as a rule does not contain workable mineral deposits, except along lines where the latite has erupted through it." There is a keynote which seems to have been overlooked. As a matter of fact, there is not a single commercial oreshoot worthy of mention in any of the andesites in this district that is not intimately associated with latites. So what is the difference anyway?

Adularia is a beautiful word! We all delight in writing and speaking it. The mere fact that it is, practically without exception in this district, microscopic and invisible to the naked eye does not keep it from being mentioned as a characteristic in all writings. It has the advantage of being perfectly safe. Who is going to have a slide made to prove it wrong? Let him beware, for he will probably find it in said slide.

This district is only just getting started. The next few years may prove it the most important gold-mining district in the United States. Nearly every important mining man in the country is financially interested in this district, and the big men do not put their money into wildcats. Of course there are wildcats roaming around these hills. No law can absolutely wipe them out. But no mining district in the country at a similar stage ever had so much good legitimate development work financed and under way. We need good honest opinions regarding the geology and other features, but we do not need any more rehashed phrases and technical terms.

J. D. SPERR,
Mining Engineer.

Oatman, Ariz., June 6, 1916.

[1]U. S. Geol. Surv., Bul. 397, p. 181.

Smelting and Selling Australia's Base Metals

SYNOPSIS—Further details of the smelting, refining and selling arrangements being made by Australian officials to substitute British for German control of the important zinc and lead output of Australia given from the Acting Attorney General's statement.

Mention has been made from time to time in the *Journal* of the effort in Australia to make the commonwealth less dependent on outside help in the smelting, refining and sale of its base metals, particularly its important production of lead and zinc, which was in German hands prior to 1915. The principle of coöperation on a scale of great magnitude has been adopted, bringing practically every lead producer into the associated smelting enterprise at Port Pirie, and the zinc producers have formed an association to market their output for a term of 50 years. The increase in the lead-smelting facilities through the Broken Hill Associated Smelters Proprietary, Ltd., and the formation of the Australian zinc-producers' association have already been commented upon, but some further details of the plan for all-British control of Australia's metal output are given in Acting Attorney General Mahon's statement, part of which is here given:

"Since the outbreak of war the metals question has been one of vital importance not only to Australia as a world producer, but also to Great Britain and her Allies as consumers, at the present time particularly in the manufacture of munitions of war, and under normal conditions for use in arts and manufactures. . . .

Associated Lead Smeltery at Port Pirie

"The problem of the treatment and realization of the large output of silver-lead concentrates from Broken Hill companies has been settled for all time. Every mining and treatment company at Broken Hill has been brought into the Broken Hill Associated Smelters Proprietary, Ltd., excepting the Sulphide Corporation, which possesses its own metallurgical works at Cockle Creek, New South Wales.

"The Broken Hill Associated Smelters Proprietary, Ltd., is practically a huge coöperative smelting, refining and realization institution for the treatment of silver, lead and gold ores and concentrates. The members of the Associated Smelters are mining companies only, producing ores and concentrates which are forwarded to the works at Port Pirie for treatment. The majority of the members have made contributions of capital, and the value of land, plant and equipment will, when present extensions are completed, amount to approximately £1,000,000. Those companies that are at present unable to contribute financially have been admitted as 'suppliers' of concentrates and are placed on exactly the same basis as regards the smelting, refining and realization of silver-lead concentrates as the most important members of this gigantic coöperative smeltery, and provision has been made for these companies to contribute capital when their financial position permits.

"The cost to all the supplying companies for smelting, refining and realizing products is the actual average cost over a stated period, plus a moderate rate of interest on capital expended on the works and equipments. The mine with the small output is, in fact, placed on almost a better basis than one with a large output, because it is securing for its small tonnage of concentrates all the advantages and economies of the largest ore-supplying companies. It is doubtful if there is another example in the mineral industries of the world where coöperation has been carried as far as in the case of the Broken Hill Associated Smelters Proprietary, Ltd. When the whole of the extensions and additions to these works are completed, the annual output of refined lead will approximate 160,000 tons, and of fine silver about 6,000,000 oz. The promoters of this coöperative smelting scheme are justly entitled to great credit for their enterprise and efforts, and also the thanks of every citizen of the Commonwealth. The practical effect of this company's operations is that the whole of the Broken Hill leady concentrates will be smelted and the silver-lead bullion refined in Australia, and the refined metals marketed under the rules and conditions of the Australian Metal Exchange. The control of this enormous tonnage of lead and silver has passed completely from 'German' to 'British' channels, and it is satisfactory to know that the demand for the company's metals exceeds the output.

Australian Zinc Producers' Association

"The spelter question has been, and still is, a matter of much concern both in England and Australia, the former as regards its supplies of metallic zinc for industrial purposes and the latter as to the disposal of its zinc concentrates, which amount to over 400,000 tons annually, containing approximately 200,000 tons of metallic zinc. For months past conferences have been held by representatives of the principal Australian zinc producers with the Prime Minister, and since his departure the Acting Attorney-General, and it is most satisfactory to be able to report to the people of Australia and Great Britain that as the result of these conferences an Australian zinc-producers' association has been established, and every important zinc-producing company controlled by local directors, and with head offices in Australia, has joined the association. The outstanding companies are those with head offices in London, and provision has been made for these and any other large zinc producers in the Empire to join the association.

"This association is a coöperative institution, the members of which are the zinc-producing companies that are pledged to sell the whole of their output of marketable ore, concentrates, spelter or electrolytic zinc, whichever may be the product of any individual company, for realization through the medium of the association for a term of 50 years. The association is not established for the purpose of profit or gain as in the case of an ordinary trading company, but as the sole medium for the disposal of its members' zinc products. The capital of this association is nominal compared with the value of the

material that it will market annually. A small commission will be charged on all transactions, and if the revenue exceeds the amount necessary for a dividend—the maximum allowable is 10%—any balance is to be rebated to the supplying companies in proportion to the value of products realized. The memorandum and articles of association stipulate for the head office to be in Melbourne; there will also be a London office. On the Melbourne directorate the Commonwealth Government will be represented by a nominee, and the Imperial Government will be represented on the London Board; thus public interests will be protected.

"At present the association controls 70% of the Australian output of zinc material—ores and concentrates—and there is every probability not only of the Australian producing companies registered in England joining, but also the Burma Corporation, which promises to be a large producer of zinc concentrates. It is more than probable that the Prime Minister, when he opens negotiations with the Imperial government for an 'Empire spelter scheme,' will have authority to speak and act for zinc-ore producing companies whose outputs will amount to 85% or even 95% of the production of zinc minerals of the British Empire. . . .

METALLURGICAL PROGRESS SINCE THE WAR

"In order that the public may have some idea of what has been performed since the Commonwealth Government adopted the wise policy of prohibiting the exportation of all minerals and metals that can be treated in Australia, it may be stated that the following-named companies have enlarged their works, installed new plant and appliances and generally increased the capacity of their various metallurgical establishments:

Broken Hill Associated Smelters Proprietary, Ltd., Port Pirie, S. A.:	
Extensions to smelting and refining works for the treatment of lead concentrates and refining of lead bullion, costing	£250,000
Electrolytic Smelting and Refining Co., Port Kembla, N. S. W.:	
Additions and extensions to plant and installation of five refining furnaces	£150,000
Sulphide Corporation, Cockle Creek, N. S. W.:	
Extensions to acid and superphosphate works for the utilization of sulphurous fumes from metallurgical operations	£50,000
There is also the probability that this company will erect a silver, lead and gold refinery in the near future, the cost of which will exceed	£50,000
Wallaroo & Moonta Mining and Smelting Co., Wallaroo, S. A.:	
Extensions to treatment plant and the installation of an additional large copper-refining furnace	£25,000
Broken Hill Proprietary Co., Port Waratah, N. S. W.:	
Important additions and extensions to its new iron and steel works.	
Mount Lyell Mining and Railway Co., Mt. Lyell, Tasmania:	
Is conducting large experiments for the recovery of sulphur. This company also has an option over a group of mines in Tasmania, and it is very probable that large works will be erected for the treatment of mixed ores from these properties.	

"Several new companies have been formed to develop further the metal industries, namely:

	Capital
Metal Manufactures, Ltd.:	
The operations of this company will cover the drawing of copper and brass wire and cables; manufacture of tubes, plates, and all descriptions of bronzes and alloys	£200,000
A company (not yet registered) for the production of electrolytic zinc	£250,000
Australian Electric Steel, Ltd.:	
The objects of this company are the working up of scrap iron and scrap steel, and the manufacture of ferro-alloys in electric furnaces	£40,000

"Several small plants have been installed for the separation of bismuth minerals from wolfram and molybdenite. Also, there has been restarting of the smelting of auriferous and nonauriferous antimonial ores for the production of fine gold and star antimony. The question of alkali manufacture has not been neglected, and plans are progressing satisfactorily for the establishment of this industry on a large scale. A carbide of calcium plant is being installed by the Hydro-Electric and Complex Ore Co. These companies also intend to work the 'Gillies' process for the production of electrolytic zinc."

These matters were referred to at some length at the meeting in London, on May 25, of the British Broken Hill Proprietary Co., Ltd. Chairman J. S. Smith-Winby, in speaking of the invitation to join the Zinc Producers' Association Proprietary, Ltd., stated that the directors did not wish to bind the company to join the association under the proposed contract for 50 years—considerably more than the life of the mine—but they were in sympathy with the general plan and would recommend to the shareholders that the company join the association provided the contract form, as finally arranged, would safeguard their interests. In regard to Commonwealth Attorney-General Hughes' plan to smelt 60% of the Australian zinc output in Great Britain and 40% in Australia and Allied countries, the chairman approved the plan of smelting 60% of the Australian output in works to be established in Great Britain, but hoped that most of the other 40% would be smelted, after the war, in France and Belgium, where the conditions as regards cost, climate and market were unquestionably more suitable than in Australia.

Tentative proposals had been made by the Proprietary directors to the British government for the support of smelting works in Great Britain to the extent of giving an order for certain quantities, say 15,000 tons of spelter and 20,000 tons of lead per annum at pre-war prices, but much difficulty was encountered in obtaining interviews beyond one or two junior officials of the different departments. The chairman hoped that the plan might eventually be attained through the consideration of the matter by an independent cabinet committee.

Regarding the smelting of lead concentrates in Australia, the chairman regarded the expense of smelting in Australia as prohibitive so far as the Proprietary company's mine was concerned, though it might not be for other mines. Taking into account the ever-increasing costs at the mine, the terms proposed by the Associated Smelters would not be profitable under normal prices, and hence the company could not follow the example of the "South" and "North" Broken Hill mines and join in the associated smelting scheme; where those two great mines could thrive, the British Proprietary company's mine might starve. Some lead concentrates, on hand at the outbreak of the war, were later sold to Japanese buyers and proposals were received from Japan to enter in contracts to smelt these concentrates for a term of years—if the German contracts were annulled—but the Commonwealth government intimated that no further metal exportations would be allowed and hence nothing further could be done along this line. After consultation with experts, the directors had come to the conclusion that the best policy for the British Broken Hill Proprietary Co. is to establish works in Great Britain to treat its lead concentrates—and probably its zinc concentrates, also.

A Consular Report From Vladivostok says that an Anglo-American syndicate has bought from the government and paid for 250 platinum-gold claims in the Ural Mountains. The mines cover the system of the Godva, Lyala, Sosva and Kakva Rivers of the Vargansk government.

Cheaper Gasoline Predicted

Officials of the Standard Oil companies are quoted in the New York *Times* as saying that the worst has passed in the skyrocketing of gasoline prices and that a reduction is to be expected soon. The hope, according to an official who has to do especially with gasoline, is based on two factors: First, that the Standard Oil laboratories have found out how to extract more gasoline from crude oil, and second, that the gasoline-producing quality of much of the oil from the southwestern field is improving.

It was explained that the present high price of gasoline was due to a combination of causes which, it was shown, it was not easy for the layman to comprehend. In the first place, there is the war. Most of the sources of production in Europe are not producing at this time. The Dardanelles being closed, the Allies cannot get gasoline from the Russian fields, and Russia isn't selling it to anyone else. The Russians and Austrians have been battling over the Austrian oil fields, and production is at a standstill there. That makes a large demand upon the American supply.

Again, the German, Austrian and Turkish markets for the byproducts of crude oil other than gasoline are cut off. That makes an over-production of byproducts, the loss of profit on which must be borne in large part by users of gasoline.

Another factor in the great advance which has set the present record price was that, two months or so ago, when the heavy production season was beginning, the production of the Cushing fields in Oklahoma fell off almost 50% and what oil continued to flow did not produce the same amount of gasoline as before.

Alaska Coal-Fields Entry

In order to make more effective the recent opening to lease of coal lands in Alaska, announced in the regulations of May 18, 1916, Secretary Lane of the Interior Department has extended the time within which applications for lease may be filed to be first considered from June 30 to Aug. 1, 1916.

Under the plan adopted, applications received before Aug. 1 will be considered together, and preference rights so awarded as to secure the largest investments and earliest development. It is the desire of the Secretary to give everyone interested in the coal-leasing proposition in Alaska ample opportunity for investment, and the extension of the time in which to submit applications is in furtherance of that policy.

The Alaska United Gold Mining Co., operating at Douglas Island, Alaska, reports profits for 1915 of $192,738 from the Ready Bullion claim and $151,254 from the 700-Ft. claim and dividends of $252,280 paid. There was 1,865 ft. of development work done on the 2,000, the 2,200 and the 2,400 levels and 4,551 ft. on No. 2 shaft. There was 183,565 tons of ore broken and 68,589 tons drawn from reserves, so that 252,154 tons were milled. Reserves on Dec. 31, 1915, were estimated at 2,288,590 tons in place and 294,515 broken, including ore in pillars, of an average grade of $2.86. Reserves at the end of 1914 were estimated at 2,144,062 tons of an average value of $2.85. The total cost of mining on the Ready Bullion claim was $0.890, of which $0.538 was for labor and $0.114 for powder and primers. On the 700-Ft. claim costs were $0.904 per ton, of which $0.465 was for labor and $0.133 for powder and primers. Total Ready Bullion milling costs were: Crushing, $0.022; tramming, $0.019; stamping, $0.182; concentrating, $0.070. Total, 700-Ft. milling costs were: Crushing, $0.037; tramming, $0.015; stamping, $0.169; concentrating, $0.052.

Semicentennial Celebration of Calumet & Hecla Mining Co.

HOUGHTON CORRESPONDENCE

There is going to be a "large" party on July 15, 1916, at Calumet, Mich. It is the celebration of the semicentennial of the Calumet & Hecla Mining Co., and the company is going to observe this 50 years of mining activity in a way all its own. It is going to be a big family gathering of all the Calumet & Hecla "folks"—the officers and directors and their families from Boston, local officers, foremen and captains and miners, millmen, smeltermen and all their families. There are about 5,500 Calumet & Hecla employees, and most of them have large families. All will be at the party. The utter impossibility of handling a crowd three times as large as the 20,000 people of the main Calumet & Hecla family prevented the extension of invitations to the employees of subsidiary companies.

The details of the program have not been worked out as yet, but there will be a parade of all of the employees and there will be half a dozen bands, headed by the Calumet & Hecla band. Every employee of the company will march in the parade, except some of the older men who will ride in automobiles. Following the parade there will be a review in the new Calumet & Hecla park. There will be a brief address by Rodolphe L. Agassiz, the president of the company, and another address by a speaker of national renown, whose acceptance of the invitation depends upon plans yet undecided.

TIMOTHY O'SHEA THE OLDEST EMPLOYEE

Perhaps, the most interesting man to take part in this party is Timothy O'Shea. He has worked for this company continuously for 50 years and six months, having had a job in the original pit. He now is employed at the Hecla, a fine specimen of manhood, enjoying good health despite his age and assuming no attitude of importance because of the unusual distinction of loyalty and continuous service.

He is but one of a large number of men who have worked for many years for this corporation. There are, altogether, 1,444 men of the 5,000 now employed who have worked steadily for this company for more than 20 years; 824 who have worked from 20 to 30 years; 480 who have worked steadily from 30 to 40 years; and 140 who have been employed more than 40 years. Such a large force of loyal, steady, competent workingmen attests the fact that the Calumet & Hecla is a pretty good family, looking at it from the standpoint of employer or employee.

MEDALS FOR OLD EMPLOYEES

Following the parade there will be fitting recognition of these men of long-time service. President Agassiz will present Timothy O'Shea and each of the 140 men who have worked for the company for over 40 years with a gold medal. This medal contains on one side a replica with the faces of the late Quincy A. Shaw and the late Alexander Agassiz, the two men who were responsible, above all others, for the success of the Calumet & Hecla as a great copper mine and a great company for which to work. On the other side of the medal will be the dates 1866-1916, the name of the employee to whom it is presented and the company name. These hand-

some and valuable medals were designed by V. D. Brenner, who designed the Lincoln penny. The employees whose terms of service are from 30 to 40 years will receive silver medals—made of silver from the Calumet mine—and the employees whose terms run from 20 to 30 years will receive bronze medals.

All the details for the day's entertainment have not as yet been worked out. It is a large undertaking—the entertainment of 20,000 people in a place the size of Calumet. In case of rain or unpleasant weather another program, suitable for indoor observance, will be substituted. So that the women and children will not be compelled to go home at the noon hour, arrangements are being made to provide free dinners for every person present. This work will not be undertaken by an outside caterer. It will be given over to the organizations of women connected with the various churches of Calumet who will be remunerated, but there will be no cost to any of the Calumet & Hecla workingmen or to any of their families.

It is interesting to observe, too, that every man will receive his full day's pay during the day of the celebration, and the most expensive item of all to the corporation probably is the loss in copper production for a single day with the present high price of copper.

The program for the afternoon includes sporting events for men and women and children, and there will be plenty of band concerts afternoon and evening. In addition to the dinner served in the open playground there will be a superfluity of good things to eat and drink at other times and a general get-together picnic.

Discovery of the Calumet Conglomerate

While the year 1916 is the fiftieth birthday of the Calumet & Hecla, 1866 being the year when the organized work actually started on the conglomerate formation, the fact remains that the discovery was made in 1865 and considerable work was done late in the fall of that year. The Calumet & Hecla company was organized in 1871 as a consolidation of the Hecla, Calumet, Scott, Portland and other minor companies. The first newspaper notice of the discovery of the Calumet conglomerate appeared in the Houghton *Gazette* of Nov. 11, 1865. It reads:

> Strange Discovery—A party exploring on the Calumet property, in cleaning out an old Indian pit in the conglomerate, on Sec. 14, found an old wooden shovel in a very good state of preservation. Its being made of hickory shows that it was brought from some distant region of the country, as none of that species of wood is to be found here. A birch-bark pail has been found in the same pit, also a piece of copper showing distinct marks of being cut with some sharp instrument. The ancient workings on this property are very extensive and now bid fair to be the most interesting of any yet discovered. They are the first we have ever heard of being found on any of the conglomerate lodes.

On Dec. 2, 1865, this paragraph appeared:

> Calumet—Reports are current of another and more extensive ancient working discovered at or near the property, but its exact locality has not come to light. The property will doubtless be sold ere long.

In the *Gazette* of Jan. 7 there was an account of the opening work done by Edwin J. Hulbert, then in charge for Quincy A. Shaw, at the Huron mine, now part of the Isle Royale and likewise in charge of the Calumet developments. The *Gazette* of Feb. 3, 1866, records the meeting of the Calumet company and the election of directors as follows: Samuel P. Shaw, E. J. Hulbert, John Leighton, Alexander Agassiz and Quincy A. Shaw.

American Mine Employees Leaving Mexico

With the negotiations between the United States and the Carranza administration in Mexico approaching the ultimatum stage and the ordering of the National Guard to the border, the leading American mining companies have for the most part ordered their American employees out of Mexico.

On June 21 the staff at the Greene Cananea mines left the Cananea district, 40 mi. south of the border, and the smelting works were closed. General Calles assured the management that the property would not be pillaged during the period of shutdown. There was an anti-American demonstration at the office of the United States consul, W. A. Julian, and some shooting at the American flag, but reports of the demonstration are stated on good authority to have been exaggerated. The Mexican employees of the company have on the whole been well satisfied, and there has been no trouble since the plant was last placed in operation, production last month having reached the maximum in the history of the company—practically 6,000,000 lb.

In the Nacozari district, in Sonora, the Americans in Pilares were rounded up on June 18 and held under armed guard for 24 hr. Orders were received from General Calles on Monday to release the prisoners, and at five o'clock instructions arrived from the Moctezuma Copper Co. for all its American employees to come out of Mexico. On June 20 about 100 Americans, including 20 women and children, were reported to have arrived at Douglas, Ariz., from Nacozari. The Moctezuma Copper Co. property will be kept open by its Mexican employees, as was done on several previous occasions when the American staff were forced to flee.

Part, if not all, of the American employees of the Real del Monte company at Pachuca, Hidalgo, were leaving the district on June 20 and were expected to proceed to Vera Cruz for embarkation, if conditions required this course. General Manager Van Law went to Mexico several weeks ago and will probably leave the property in the hands of local Mexicans and Englishmen.

The American Smelting and Refining Co. has had none of its American staff in Mexico for several months, its properties being idle except for Mexican caretakers and such work as might be done without expert supervision. The Mines Company of America likewise has not attempted to operate any of its properties in Sonora and Chihuahua for some time and has no American employees in the country. The Batopilas Mining Co. ordered its men out of Chihuahua in the latter part of May after a bandit visit; they came out by way of Lluvia de Oro, at which time there were some Americans at that property. It is not known whether the Lluvia de Oro staff has left.

On May 23 President A. J. McQuatters of the Alvarado Mining and Milling Co. and about 30 men proceeded to Parral, Chihuahua, to reöpen the company's properties there. No information regarding their movements is at hand at the time of going to press.

Gray Acetate of Lime has been classified as an important constituent of military explosives, and the British Minister of Munitions calls attention to the fact that dealings in it are now subject to the restrictions imposed under Defense of the Realm Regulations.

Will American Capital Be Attracted to the Far Eastern Rand?

By A. Cooper Key*

SYNOPSIS—W. W. Mein, consulting engineer, of New York, with his associates, Messrs. Hoffman and Searle, sailed from Capetown in the middle of May, after having spent a month investigating the potentialities of the Far Eastern Rand for the American Rand Syndicate, which has been formed by Adolph Lewisohn, associated with Messrs. Lewis and Marks, of London and Johannesburg, which firm controls the East Rand Mining Estates, in turn possessing rights over a considerable tract of the Far Eastern Rand. The entire area which awaits the development comprises upward of 250 sq.mi. and is conservatively estimated to carry £450,000,000 worth of gold. Whether American capital will develop this field depends of course upon its measure of attractiveness. Mr. Mein will spend a few days in London and will then report to his principal and financial associates in New York. In these circumstances the report of Mr. Kotze, the Union of South Africa government mining engineer, appears most opportunely. It was issued a couple of days before the mail left Johannesburg.

The great importance to the Union of South Africa of the opening up of the area known as the Far Eastern Rand will be appreciated from the calculation of R. N. Kotze, the government mining engineer, that if only one-half of the 73,988 claims not held by producing companies in this area and containing reef at a depth of less than 5,000 ft. prove remunerative, after a deduction of 60% for nonproductive zones (assuming a stoping width of 4¾ ft., a dip of 7 deg. and a sorting of 20%), on a yield of 27s, 6d. per ton the yield of gold would be approximately £450,000,000,

Size and Geological Characteristics

The memorandum on the Far Eastern Rand is a most thorough exposition of the features and development aspect of this important district extending east and west for about 20 mi. from the south of Boksburg to just west of Endicott Station—that is, to the sub-outcrop of the main reef series—and from a point 7½ mi. north of Welgedacht Station to the Nigel, about 22 mi. The reef-bearing area is 247 sq.mi., or about 107,440 mining claims. It is traversed by three railway lines. Although not geologically a basin, the section may for practical purposes be considered as such, since on all sides but that next to the reef it has an outcrop or sub-outcrop. The only reef series that can at present be considered of economic value is that correlated with the main reef series, and specifically by Dr. Mellor of the Union Geological Survey with the main reef leader. It is estimated from mining and bore-hole data that over 203 sq.mi. (equal to 88,191 claims) of the reef lie at a depth of less than 5,000 ft. Although it is somewhat doubtful whether reef situated at a vertical depth of over 5,000 ft., with the information at present available, should not be excluded as unprofitable, ground falling within the area considered and containing reef in excess of that depth has been included in the discussion. There are 19 farms within the area which have been proclaimed under the Gold Law. They comprise 42,577 claims, of which 18,045 are held by existing mines and 6,404 claims are otherwise held. There are 18,128 claims available for leasing on these farms. There are also 22 farms or parts of farms containing 64,863 claims, of which the portion containing reef at a vertical depth of less than 5,000 ft. accounts for 48,396 claims. Existing producing companies may be looked upon broadly as being already adequately provided with capital. The balance of ground, excluding areas with reef at more than 5,000 ft., is 73,988 claims which will require capital for development and exploitation. For a working company this may be roughly estimated at £1,000 per claim, but a large allowance for certain sections which may never prove sufficiently attractive to capital must be made. Roughly, about £50,000,000 will be needed, spread over a number of years, for caution must necessarily be exercised in the opening up of new ground in order to minimize heavy losses unseparable in proceeding from proved to unproved territory. A prudent financial policy will discourage the taking of too long leaps in the dark. It will be seen that there are available for leasing on proclaimed ground 16,842 claims when the other farms are proclaimed, out of a total of 64,863 claims; some three-quarters, or 48,000, is the balance accruing to the owners of the farms or will become available. Of the total of 65,000 claims, 49,200 contain reef at less depth than 5,000 ft. Coal measures occur on the great majority of farms in the area.

What the Producing Mines Have Achieved

There are 11 producing mines in the area: Brakpan, Geduld, Government Gold Mining Areas, Modder B, Modder Deep, New Kleinfontein, New Modderfontein, Van Ryn Deep, Van Ryn, Nigel and Sub-Nigel. They control 14,203 claims and have produced £43,010,510 worth of gold, equal to 32s. 3d. per ton. Dividends have amounted to £11,140,000, representing 8s. 4d. per ton. The official life ranges from 6 to 40 years, and averages 21 years, but several have notified their intention of increasing their reduction plants, which naturally will accelerate the exhaustion of the ground. Coal measures cover the greater portion of this gently undulating country, but over a stretch of 17 mi. they have been denuded, exposing the underlying dolomite. The width of this stretch averages 2½ mi.; but in the northern part of the area under notice, it is as wide as 9 mi. The wide distribution of the dolomite, with its accompanying water, has in certain instances added considerably to the difficulty and cost of shaft sinking, and has also increased mining costs. The Geduld, for instance, averaged 1,826,000 gal. per 24 hr. and the Spring Mines 1,952,000 gal., during the three years ended December, 1913. The gen-

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eral range in the cost of shaft sinking has been about £30 per ft. for shafts from 2,500 to 3,000 ft. deep, up to £50 for shafts from 3,000 ft. to 4,000 ft. and where great quantities of water have been encountered. The average dip assumed is 7 deg. Mining and boring operations have shown that over almost the whole area only one reef is likely to be worked, though there are exceptions in the case of the Van Ryn (four reefs in places) and Kleinfontein (three reefs in certain sections). For the purposes of estimation an average width of 4¾ ft. has been assumed.

Ratio of Productivity in Poor Zones

In most mines there are nonproductive areas from which no ore is obtained; it has never been deposited or has been cut out by dikes, is required for support or is so narrow and of so low a value as to be unpayable. The proportion nonproductive is smaller in the outcrop mines in the northwest portion of the area. The percentage varies from 15 to 80 in different mines, on the basis of existing relations between recovery and costs. In estimating the possibilities of ground still to be worked, 60% is assumed as nonproductive; this will naturally be too optimistic in certain cases and too drastic in others. There are indications that the poorer ground lies in certain directions, but existing knowledge does not permit any clear line of demarcation between payable and unpayable areas. Further exploration will in time, no doubt, indicate the promising sections more definitely.

Minimum Financial Requirements

In the 1908 Act it is laid down that the area to be leased shall constitute a workable mining proposition. In determining the minimum size many factors have to be considered and a fairly liberal margin must be allowed, otherwise the proposition becomes unattractive. An error on the large side makes the proposition more attractive; one on the small side might make it hopelessly unpayable. Mr. Kotze lays down the financial aspect of a "working mining proposition" as one returning annually over 20 years, after paying its share of profits to the government, a dividend of at least 15% on the capital sunk, with amortization of capital at 3%. Capital is regarded as the expenditure on shafts, equipment and development with interest at 6% to commencement of production. "These assumptions necessitate a dividend of 18¾% on the accrued capital when the life is 20 years. This may seem high, but considering the risks run, such an expectation is by no means an unreasonable demand. Of the areas available for leasing the most attractive and suitable are those lying alongside proved payable mines, as Brakpan, Geduld and Springs. The following may be assumed to be the average reef conditions: Proportion nonproductive 60%, dip 7 deg., stoping width 4¾ ft., sorting 20%, total tonnage per claim 9,000, depth 3,000 to 5,000 ft." In the Springs Mines the ore reserve per end December, after mixing with one-ninth its quantity of low-grade ore from other sources would yield a recovery of 45s.; Daggafontein assays indicate 29s. 8d. A recovery of 27s. 6d. per ton milled may be reasonably assumed.

The memorandum explains the terms of the lease on Modderfontein No. 167 (Government Gold Mining Areas, and now yielding £70,000 gold a month), refers to the two offers of 2,237 claims on Brakpan and Schapenonst to which no response was made and to the offer of lease on Witpoortje No. 12, for which one tender was received but not accepted. It is worth noticing that the area offered was 1,180 claims, apparently much less than required for a workable proposition unless exploited by the Rand Collieries Co. In contemplating the leasing of an area lying between the Geduld Proprietary and the Springs Mines, an arrangement has been concluded with the Geduld Deep for inclusion, while 650 claims lying between Modder B., Rand Klip and Cloverfield have been beaconed off and surveyed in similiar anticipation.

Present Procedure Inelastic

Mr. Kotze quotes sections 30, 46, 48, 52 and 53 of the Gold Law of 1908, which deal with the leasing of mineral rights. They embody a principle and prescribe methods of procedure novel in character. The principal section (46) is too inelastic, and after seven years' experience it can be definitely stated that the law requires amendment in several respects if progress is to be made in the leasing of mining ground. Some areas are so small that they can, like *bewaarplaatsen,* only be dealt with by existing companies and this is now impossible. The whole initiative is within the government, which may select unsuitable areas and invite tenders at inopportune times. The period for tendering is unduly long; "initiative should be left with the parties who provide the capital; details of area, capital, share of profit offered, to the government." The authorities can decline the application, or it can be modified by negotiation. A strong advisory board to advise the government on all matters pertaining to leases should be created, as alternative machinery to that at present existing. The condition that the lessee shall within a specified time provide capital required for equipment is onerous, and when areas are to be worked by adjoining companies, not entirely applicable. In certain instances lessee should be permitted to put up only sufficient capital for preliminary work; if this yielded unsatisfactory results, he might prefer to drop the lease.

Proposed Modification of Procedure

It is provided in the 1908 Act that the lessee pay a percentage of the net produce as may be agreed upon to the government. The government mining engineer proposes to amend this so that the lessee should pay the ordinary statutory profits tax of 10% subject to capital, amortization allowance, and such further share offered and agreed to. Such division of the government's share will show more clearly than at present what amount the government will receive as partner in the lease. Provision should be made for the further share being commuted into lump sums or into fixed annual payments. Special supervision of the lessees' work should be unnecessary, for this reason any assessment based on the ton which is not accurately and automatically determined would not be acceptable. Profits cannot be falsified except by devices detrimental to shareholders. Profits should form the basis and the government's royalty can well be expressed in the form of a percentage. As it cannot be foreseen whether any particular area is going to be highly profitable, moderately profitable or even unpayable, the government's share should be expressed in the form of a sliding scale. Here again, the ton basis is unsuitable, and there would be constant trouble if the lessee were to have to pay the government a percentage

of profits rising with the profit per ton. A safe basis is the ratio of profits to recovery as adopted in the Modder lease and the other offers. It should be so devised that, while the government gets a larger share of profits when these increase owing to higher grade, it should not increase unduly when enhanced profits are attributable to reduced costs. Otherwise, efficiency would be penalized. Mr. Kotze does not say so, but this is one of the defects of the Modder lease scale.

Comparison of Present and Proposed Scales

It does not appear clear whether he intends that the example he gives, illustrating a general formula, should be interpreted as a definite recommendation. But if so, adding the statutory 10% tax on profits as recommended (about 9% in practice, allowing for amortization), the total sums accruing to the government would be:

Ratio of Profit to Recovery, %	Tax, %	Sliding Scale, %	Total, %
10	9	0.0	9.0
15	9	6.7	15.7
20	9	10.0	19.0
25	9	12.0	21.0
30	9	13.3	22.3
40	9	15.0	24.0

The total royalties compare favorably with those which would be payable under the Modder lease (same percentage of profit as latter bears to production plus additional amount as agreed) and with the minimum consideration proposed in the Brakpan-Schapenonst offer. At the same ratios these figures would be:

Ratio of Profit to Recovery	Modder Lease	Brakpan-Schapenonst Offer
10	10½	10
15	16	15
20	22	20
25	27½	25
30	33¼	30
40	47¼	37½

Is the Owner's Share Adequate?

Under the present law the owner of the farm is entitled to mineral rights on one-fifth of the area to be proclaimed "discoverer's claims," and additional claims if discovery is made by boring or shaft sinking. The area generally works out at about one-third of the proclaimed area. It is felt by freehold owners in this area that, owing to narrow width of reef, flat dip, large proportion of ground unprofitable and the great depth, the proportion is inadequate. Making the assumptions previously given (that is, dip 7 deg., 40% payable, 9,000 tons a claim, recovery 27s. 6d., costs 18s. to 19s. 3d. per ton, return of 15% on accrued capital with amortization at 3%), Mr. Kotze gives estimates of areas required to form workable propositions which may be thus summarized:

SIZES OF WORKABLE PROPOSITIONS

Depth of reef, ft.	1,000*	2,000*	3,000†	4,000‡
Costs per ton	19s. 3d.	18s. 6d.	18s. 3d.	18s.
Milling proclaimed area, tons	340,000	400,000	600,000	1,000,000
Total capital expenditure	£612,000	£768,400	£1,120,000	£1,855,000
Years nonproductive	3	4	5	7
Accrued capital	£686,390	£880,588	£1,356,286	£2,320,340
Annual profit	£128,503	£164,860	£253,918	£434,404
Amortization	25,544	32,772	50,475	86,353
Total tonnage	6,800,000	8,000,000	12,000,000	20,000,000
Number of claims refused	756	889	1,333	2,222

*Two shafts. †Three shafts. ‡Four shafts.

It is also shown that ground in which the reef occurs at 5,500 ft. is unable to fulfill the financial conditions stipulated, returning only 11 or 12% on the accrued capital. In some instances the areas accruing to owners are less than the minimum required to constitute workable propositions. To remedy this the owner might be allowed to apply for a lease of adjoining ground before proclamation, or the grant of discoverer's claims in recognition of boring might be extended to the case of shaft sinking. The whole question does not admit of definition in law; it should rather be the function of a mining-leases board.

Waning Fortunes of Central Rand

The government engineer refers to a statement presented to the Dominion's Royal Commission that of the 52 Rand mines now producing only 33 would be still working by the end of 1924; in 1934 only 20, and in 1944 only eight. Two new producers have entered the list, but there is but one developing mine, so that for many years to come there will only be this one addition to the list. Five or six years must elapse before the producing stage is reached, even with circumstances favorable and if nothing untoward happens. The delay in arranging leases must be added to this, still further increasing the time elapsing before any new producer can come into the field to assist in counterbalancing the decline owing to the exhaustion of present producing mines.

The whole question, it should be added, is being investigated by a select committee of the Union House of Assembly, which conducts its proceedings *in camera*.

Foreign Trade in Lead and Zinc

The imports of lead into the United States for April and the four months ended Apr. 30 are reported by the Department of Commerce as below in pounds:

	April	Four Months
Lead in ore	3,243,475	9,133,471
Lead in base bullion	142,374	13,793,189
Lead, metallic	2,267,735	2,543,659
Total lead	5,653,584	25,470,319

The actual tonnage of ore was 9,871 tons, of which 6,749 tons came from Mexico, 1,556 tons from Canada and the remainder from other countries, including zinc ore from Italy, containing 1,000 tons of lead. The base bullion was all from Mexico.

Imports of zinc in all forms in April and the four months ended Apr. 30, are reported by the Department of Commerce as below, in pounds:

	April	Four Months
Zinc in ores	31,416,141	127,889,337
Metallic zinc	125,966	561,862
Zinc dust	89,317	868,570

All of the zinc dust imported in April came from Japan. The total ore imported in April was 37,510 tons; 15,260 tons being from Mexico, 162 tons from Guatemala, 2,298 tons from Canada, 12,673 tons from Spain, 1,000 tons from Italy, 2,219 tons from China and 3,898 tons from Australia.

Exports of zinc from the United States in April and the four months ended Apr. 30, were, in pounds:

Exports	April	Four Months
Zinc, pigs, bars, etc., from domestic ore	9,373,105	47,078,898
Zinc, pigs, bars, etc., from foreign ore	2,424,003	18,473,546
Zinc plates and sheets	8,373,234	25,562,349
Zinc blocks, etc., reëxported	.....	336,000
Total metallic zinc	20,170,342	91,450,793
Zinc dross	.....	3,211,446
Zinc dust, reëxported	1,000	97,419

Editorials

Progress in the Mexican Situation

With the calling into Federal service of practically the entire National Guard of the United States on June 18, another step in the international relations between the United States and Mexico was taken that was in perfect conformity with the logic of events. For several years logic has pointed to the eventual intervention by the United States in Mexican affairs, merely as a matter of self-protection, for this country could not safely permit an indefinite continuance of anarchy in a neighboring state. By the exercise of a strong hand, with knowledge of real conditions in the first place, military interference might have been averted. But by the pursuance of a policy of watchful waiting, vacillation and mushiness, we have all along been leading to precisely the thing it was sought to avoid.

The Mexican people, in behalf of whose right to slaughter and pillage the President of the United States spoke eloquently a few months ago, hold us in contempt, remarked the New York *Sun* in its summary of the latest event. They believe that they are our superiors in courage, in devotion to country, in all the virtues that appeal to men not too proud to fight. In this lies the explanation of the humiliating occurrences that have compelled the War Department to put our entire mobile army in Mexico or on the border, to strip our coast defenses of men, and finally to mobilize the National Guard of all the states. We should amend this only by substituting for the Mexican people, a part thereof, for we believe that a large element of the Mexican people know better and will welcome the American intervention that will enable them once more to live in peace and in such happiness as they may be able to extract from the condition of their unfortunate country.

Wise or unwise as the policy of the Washington government heretofore may have been, there is no use in engaging in further recriminations. What has been done is done and cannot be undone. It is the duty of every American citizen now to stand with his country and render such service as may be required of him. The calling out of the National Guard will draw many mining engineers from their peaceful employment and will leave gaps in the offices and works. This is one of the consequences of a country going to war, or getting ready for it.

The calling out of the National Guard does not mean immediate hostilities. The primary purpose is to have an adequate number of troops ready for the defense of our Mexican frontier. The National Guard has not yet been ordered to the frontier. Even after it has been, if that happens, war may still be averted. However, the logic of events points to eventual intervention and the mobilization of our troops is simply another step toward it.

We do not believe that war will come now. It seems foolish even to talk about it. The idea of Mexico declaring war on the United States is simply ridiculous.

Secondary Enrichment of Copper Ores

During the last few years the efforts of mining geologists have been largely directed to the questions connected with the enrichment of copper ores, while other problems have in a measure been neglected. There has been an open competition in these studies between institutions of learning in the extreme East and in the far West, sometimes so eager as to be amusing, the price to be captured being the possible important conclusions of economic interest. The United States Geological Survey has done surprisingly little along these lines, though important investigations in enrichment of silver ores are now in progress in that bureau.

One encouraging sign is the readiness to recognize that the mere examination of the ores is not enough, but that it must be supplemented by research as to the stability of the minerals concerned and by investigation of the physiographic changes that have taken place in the districts studied. Great progress has certainly been achieved, but the problem as to copper is far from being conclusively settled. The controversies mainly refer to chalcocite and to its mode of deposition and its relation to the water level.

Long before 1900 sulphides of late origin were observed above and below the water level, but their secondary, or "supergene," origin by descending waters was not recognized until De Launay in 1897 pointed out the existence of such products above the water level. In 1900 Emmons, Van Hise and Weed established the supergene sulphide zone at and below the water table. Then followed a time during which all chalcocite was considered "supergene" and the occurrence of this mineral above the water level was attributed to subsequent lowering of the water. The unexpected persistence of the chalcocite in depth at Butte created an uneasy feeling among some people, who felt that it was going far too deep for "supergene" waters. Then "eutectic" intergrowths of chalcocite and bornite were found in depth at various places supposed to indicate simultaneous deposition, and gradually the belief became current that some chalcocite was deposited by ascending hot waters, that it was of "hypogene" or primary origin. Some observers even went so far as to question the supergene origin of covellite, to which most mining geologists had clung tenaciously. The criterion as to the massive character of the hypogene versus the "sooty" character of the supergene chalcocite was established but soon rejected.

From Stanford University the "upward secondary enrichment" theory was brought out, involving change and enrichment by late ascending solutions, and afterward came the theory of dispersion of older sulphides into colloid suspension and redeposition by such solutions.

So that as a result of all this the mind of the average mining geologist is slightly confused. He knows that there is hypogene and supergene chalcocite, but how is he to distinguish the two? To add to his troubles and

worries, late investigations seem to show that the so-called eutectic intergrowth is not eutectic at all, but instead the result of replacement of bornite by chalcocite. A ray of hope breaks through these colloid suspension theories. The Geophysical Laboratory of the Carnegie Institution has ascertained that chalcocite formed below 91° C. is rhombic, whereas it crystallizes in the isometric system above this temperature. Now then, as most mineral deposits were probably formed primarily above 90° C., this is a criterion worth having. Unfortunately chalcocite may show "inherited" structures from other incarnations—for instance, from bornite—and so it devolves upon the investigator to determine whether it really is chalcocite structure or whether it only looks like it. It is hoped that the reader now realizes some of the difficulties the copper experts are up against.

So much good work is being done that the next few years will doubtless show positive and reliable results. At the present writing it looks as if most of the chalcocite and all the covellite were deposited by reactions generally caused by descending waters, but perhaps in some cases by solutions of primary or ascending character. It is also known that the much-investigated minerals, while usually forming at or below the water level, may under circumstances also develop above that level of complete saturation.

Iron and Iron-Ore Supplies

For at least four months of the current year our blast furnaces have been making pig iron at the rate of about 40,000,000 tons a year, and the indications are that this production will be kept up for the remainder of 1916. With our present iron-making capacity this is as much as can be expected; indeed, it is possible that the rate may fall off a little, as the intensive working required to keep it up may cause the blowing out of more stacks for repairs. In the three years 1912-1915, the additions to works made were mainly to increase steel-making capacity, and but few new blast furnaces were built or started, so that there has been but a moderate increase in the quantity of pig iron that can be produced. Some steps have been taken toward an increase in the number of stacks, but it will be well toward the end of this year before these new furnaces can be in blast.

While it seems possible that our furnaces may reach a total make of 40,000,000 tons this year, it has been suggested in some quarters that the iron-ore supply available may fall short of requirements. This does not seem probable. The iron-ore production in 1915 was, in round figures, 55,500,000 tons, of which 46,900,000 tons came from the Lake Superior region and 8,600,000 tons from other sources. To this production is to be added something like 2,500,000 tons of imported ores and of mill scale and cinder, zinc and pyrites residues and other similar material. The Lake ores are not only the larger part of the ores in bulk, but the highest in grade, with very few exceptions, so that they furnish at least 80% of the raw material needed. Under present conditions also, it is in the Lake region where the iron ore output can be most quickly and largely increased. The outside districts in the past have been more uniform in their output, showing much less fluctuation in quantity, though developments of the past year or two have made possible a considerable gain in the South.

With 40,000,000 tons of pig iron to make, it would seem probable that the Lake mines will be called on to ship some 64,000,000 tons of ore. They have begun well at the task. Up to the end of May over 10,000,000 tons has been shipped, though the opening of navigation was late and the five months June-October ought to make up nearly the balance, without counting the uncertainties of November. The only point of doubt to be considered is a possible shortage of labor, and that has not yet developed.

The ore mines outside of the Lake region can show a good increase, if required, especially in the South. Already preparations are in hand for a considerable gain in New York and New Jersey. Much increase of imports cannot be expected until there is a material change in the ocean-freight situation. But with our own supplies there seems very little doubt that the blast furnaces, with such additional stacks as may be completed, will be able to work to capacity for a year to come, or until we reach the period of reaction to which all past analogies of the iron trade teach us to look forward.

Zinc Oxide from Zinc Ashes

A new feature in American zinc metallurgy is the recovery of additional zinc from the residues remaining after distillation in the retorts. Of course, about all the zinc capable of reduction and distillation ought to be extracted in the retorts, but in American practice the distillation is not ordinarily performed at high temperature, relatively speaking. Probably the furnaces and retorts of the American clays commonly used would not stand it. Therefore there remains in the discharged residues a considerable proportion of zinc that can be burned off by other means, can be collected as oxide, and there is sufficient unburned reduction coal in the residues to effect that.

This supplementary extraction of zinc was first done at Bartlesville, Okla., where the burning was conducted in heaps. Some work in this direction was also done at Cherryvale, Kan. Several companies are now planning to do this by means of Wetherill grates, either making pigment or crude oxide to go back to the spelter furnaces. The cost of the burning is estimated as low as $2 per ton, which is not unreasonable, considering that no coal has to be bought.

Steam Shoveling vs. Caving

In discussing the opening of a new mine that is now being considered, we remarked to the manager: "Well, this will be a steam-shovel operation, will it not? You've got ore from the grass-roots down." He replied that he was not sure about that. "You see," said he, "they have been doing such wonderful things in underground mining at the Inspiration that I'm thinking it may be best to avoid some of the troubles of openpit work and start right in underground."

Without any doubt the performances at the Inspiration mine exemplify the last word in modern mining practice. With an extraction of ore for 50c. per ton, with the prospect that the cost may be reduced to 40c., the figure is not very far away from steam-shovel cost, and there are no deferred charges, etc. The automatic ore hoisting at Inspiration is one of the unique things in mining.

BY THE WAY

On his last trip to New York the late James J. Hill was nettled by the insistence of many people that he tell them when the war in Europe would end. He said impatiently: "If you want to know when this war will end I will tell you; it will end when somebody gets licked, and somebody has got to get licked before it ends."

A novel method has been adopted by the Nevada Packard Mines Co. to ascertain the wishes of stockholders as to whether dividends should be paid now, or a large cash reserve built up. Accompanying notice of the annual meeting July 5, are blanks on which the stockholders are invited to record their wishes, and whatever the majority votes will be done.

A suffering traveler beseeches the Dorr company to get out a line of small thickeners for country-hotel proprietors to use on their coffee. A "clear coffee overflow" could be guaranteed, the s. t. thinks, and the grounds could be settled to a greater density than can now be obtained by the guest through free settlement in his coffee cup. In this way the securing of clear solution could be removed from the feeding period and placed in a separate closed circuit.

Seven bays of the hollow reinforced-concrete dam built on glacial drift at West Brook reservoir, City of Plattsburg, N. Y., failed at about 9 a.m. on May 15. Six of the 22 bays, or 90 ft. of length, were torn out and pieces washed a mile downstream. "This apparently was due to the destruction of foundations under bays 3 to 7 after several weeks' leakage." Far be it from us to invade the sacred precincts of civil engineering with criticism, but we have a mental picture of a mining engineer trusting "glacial drift" for a foundation.

Life in a powder mill can never become particularly monotonous, says the *Boston News Bureau,* and one of the factors which contribute to the interest in life is the fire escape. The different "houses," or units, of which a powder plant is made up are built two stories high. It is often extremely desirable to have a handy, rapid exit. Accordingly, at intervals of perhaps 50 ft., chutes are constructed, half-round in section and at an angle of perhaps 30°. Instantly an alarm is given, the workman dives head foremost into the nearest chute and is deposited, some half-second later, safely on the ground, except that a little skin may have been worn off. A recent visitor says this is part but not all of the story, because it neglects to mention the presence of a large pile of sawdust at the bottom of the chute immediately in front of which is a pool of water to act as a cooler during the "flare up."

Tim Huzzy, an old-timer of the Cripple Creek gold district, long ago went on his last prospect. But his doings and sayings, according to *Engineering and Contracting,* still furnish many an anecdote at any gathering of the Argonauts. One time Tim was engaged in a lawsuit, and as he did not have any money for attorney's fees, he agreed to give his lawyer one-eighth interest in the mine for his professional services. The next day Huzzy called on the lawyer. "The deal is off," said the redoubtable Tim. "I can't give you a one-eighth interest. It is too much. I'll only give you a quarter interest, and if you won't take the case for that, it's no go." Tim was a great hand in disposing of one-eighths in his gold mine to secure funds for further operations. In fact, some merchants who had staked him, in comparing their lucky investments, found that Tim had sold quite a few eighths. They called him to account. Tim at once got mad. "Phat do you think I have," he exclaimed, indignantly, "one of those ordinary prospects with only eight-eighths? No, siree! I have a rale gold mine with eighty-eighths."

This is related by an engineer: I called at an instrument maker's to have a little attachment put on my compass-clinometer that I had schemed out. The clerk was very polite.

"I want to save money for you," said he. I told him that was kind and thoughtful of him.

"Yes," he continued, "If we can devise something that can be made by my handy man, it probably will not cost as much as if we have to send it out to the factory. Then it would be a time job."

"Like what they are in automobile repair shops," I remarked, recalling a recent bill for five hours of misdirected effort that was charged up as eight hours at 75c. per hour.

"Just so," replied my friendly clerk. As I came away I fell to thinking of that dreadful expression TIME, the fetish of organized labor, and of unorganized also, I fear. The fundamental consideration is not WORK, but just time. It is the revolution of the hands of the clock that counts, not accomplishment. The plumber who goes to his work without the necessary tools is thinking more of his time than of his work and renders a bill that incorporates some petty larceny.

In the gasoline-price inquiry now going on in Washington, independent oil jobbers testified before the Federal Trade Commission that the Standard Oil Co. had demoralized the oil industry, and through failure of the units of the company to compete in one another's fields, had jeopardized the existence of independent jobbers and refiners. They declared that arbitrary high prices set by the Standard Oil in Ohio and Eastern States had diverted the flow of oil from the independent refineries of the Middle West until the independent jobbers of the West, where a lower retail price is set by the Standard Oil Co. of Indiana, no longer were able to buy crude oil at prices which would permit them to compete with the Standard company. E. B. Carson, representing the Consumers Refining Co., declared, according to the New York *Times,* that the profit made by his concern had not been through the sale of gasoline, but through a rise in the price of crude oil. "The Consumers company put 2,000,000 barrels in storage when we couldn't get 30c. a barrel for it," he said, "and sold some of it for as much as $2 a barrel. The big profits in the year came from our gamble on crude oil." Quite all right for the independents to benefit by a 700% advance in the market (due to most everybody getting the automobile bug), but quite wicked for the Standard to do so.

PERSONALS

John Carson, recently at Sierra Madre, Calif., is now at Mullan, Idaho.

R. B. Brinsmade, recently in Mexico, is now at St. Louis and expects to remain there for a time.

A. T. Spring is at Boulder, Colo. He was recently with the Utah Metal Co. at Bingham Cañon, Utah.

A. W. Newberry, of San Francisco, is spending the summer in Peru and Bolivia on professional work.

W. H. Staver, lately at Ophir, Colo., has opened an office at Lynchburg, Va., expecting to specialize in manganese.

W. G. Matteson has accepted a position as geologist with the Empire Gas and Fuel Co., of Bartlesville, Oklahoma.

Robert E. Cranston left San Francisco June 13 for Elko, Nev., to make an examination of the Lucky Girl mine, in the Edgemont district.

Alexander P. Rogers has returned to New York from a long professional trip to South America and is now at the Ray Consolidated offices.

Whitman Symmes was in San Francisco early in June negotiating for electrical equipment for deepening the Mexican-Union shaft on the Comstock.

The Guggenheim Brothers, who already had given $500,000 to the institution, have made a new contribution of $165,000 to Mount Sinai Hospital in New York.

Corey C. Brayton and **E. R. Richards** have opened offices in the Hobart Building, San Francisco, for the practice of mining and metallurgical engineering.

Frank Carroll, for three years Alaskan manager for the Ingersoll-Rand Co., has resigned and left for the States early in June. He has no definite plans for the future.

Edward L. Estabrook has returned from two years of geological work in north China and has located at Platteville, Wis., as geologist for the Wisconsin Zinc Co. there.

Dr. A. J. Lanza, of the United States Public Health Bureau and **D. Harrington,** of the Bureau of Mines, are now in Butte, Mont., inspecting health conditions in the Butte mines.

Prof. R. C. Wallace, provincial mineralogist of Manitoba, has gone to make an examination of the Rice Lake gold field, which is attracting large numbers of prospectors and miners.

F. L. Culver, president of the Beaver and Temiskaming mining companies of Cobalt, Ont., has acquired a large interest in the Schumacher, of Porcupine, and been chosen a director of the company.

Frank H. Probert wishes to advise his professional colleagues and clients that after July 1, 1916, his permanent address will be University of California, Mining Department, Berkeley, Calif.

Joseph B. Cotton, of Duluth, Minn., prominently identified with the Cole-Ryan copper interests as legal advisor, will open offices in the Equitable Building, New York. His Duluth offices will also be retained.

Arthur W. Stevens has just returned to Denver after making examinations of properties in the Idaho Springs district, and has left for Salt Lake City where he will spend several days examining properties in Utah for Eastern principals.

R. B. Shover, formerly general superintendent of the Brier Hill Steel Co., Youngstown, Ohio, and for the past two years general manager of the Tata Iron and Steel Co., at Sakchi, India, has resigned and will shortly leave for the United States.

Charles P. Perin, New York, has sailed for London, going thence to India. At Bombay he will present to the directors of the Tata Iron and Steel Co. a report on the projected enlargement of the company's plant at Sakchi. Mr. Perin will be absent about four months.

M. H. Atwater is general manager of the Broadwater Mills Co., of Park City, Utah, which is operating a 600-ton mill on the complex lead, iron and zinc ores of Park City. He is also in charge of the erection of the electrolytic zinc plant for the Judge Mining and Smelting Co. at Park City.

James M. Nelson, who recently resigned as superintendent of the open-hearth department of the Carnegie Steel Co.'s Ohio works at Youngstown, has just been appointed superintendent of the open-hearth and duplex steel departments of the Algoma Steel Corporation at Sault Ste. Marie, Ontario.

A. P. Busey, manager of the Penn Mining Co. at Campo Seco, Calif., returned to the mine from San Francisco on June 10 after attending the trial of the smoke-belt farmers against his company for damages. Six of the 37 cases were tried in one hearing in the U. S. District Court and a jury verdict rendered for defendant in half an hour.

Albert de Deken, a well-known Belgian chemist and metallurgist, who has been in this country the past nine months, sailed from New York June 10 on his return. He was connected with the steel industry in the United States for a number of years, having been chief chemist of the Carnegie Steel Co. some years ago.

Territorial Senator Charles A. Sulzer, former manager and present lessee of the Sulzer Copper Mines at Sulzer, Alaska, was nominated by the Democrats of Alaska to run for delegate to Congress against the present incumbent, James Wickersham. Sulzer is very popular and will tour interior and southwestern Alaska before election.

H. S. Snow, manager Wisconsin Zinc Co., Platteville, Wis., assumes the duties of traffic manager of the American Zinc, Lead and Smelting Co. July 1 with headquarters at St. Louis, Mo. **H. C. George,** formerly chief engineer of the Wisconsin Zinc Co. has succeeded to the position vacated by Mr. Snow. **Carl Hayden** takes the engineering work of Mr. George and **Ned Estabrook** takes the geology and field work.

OBITUARY

John L. Stranahan died at Boulder, Colo., June 3, aged 82 years. Born in Connecticut he had lived and worked in Chicago and elsewhere before going to Colorado. He was prominent in the early days of Cripple Creek. He went to Boulder in 1890, and built himself a residence at Lakewood. In 1901 he acquired 70 acres of rich tungsten land at Lakewood, which subsequently became valuable with the rise in the price of the metal. An offer of $50,000 for a portion of the ground was recently refused by him. In his earlier days he was noted for his great size and strength.

William Nelson Merriam, geologist for the U. S. Steel Corporation, died June 13, at Duluth, Minn. Mr. Merriam had been in poor health for some months, as result of an apoplectic stroke. He was 56 years of age, having been born in 1860 at Waupun, Wis. He graduated from the University of Wisconsin. In 1882-88 he was with Lake Superior Division of Pre-Cambrian Geology of the U. S. Geological Survey. In 1889-97 he did geological work, mainly in the Lake Superior region for several companies. In 1898 he became geologist of the Minnesota Iron Co. When that company was absorbed by the Steel Corporation in 1901 he became chief geologist of the Oliver Iron Mining Co. at Duluth. He was a member of the American Historical Association, Mining and Metallurgical Society of America, American Iron and Steel Institute and of many other clubs and societies.

SOCIETIES

Northwestern University—The department of geology will conduct a geological field course in the Lake Superior region during August. It will be devoted largely to a study of the Pre-Cambrian rocks with some attention to the Pleistocene history.

California Metal Producers' Association—The second annual California field meet which will include contests in first-aid to the injured and mine-rescue work will be held at Sacramento during the State Fair on Sept. 6. It is expected that this meet will attract a large crowd and every possible effort will be made to make it as great a success as was the meet held last September in connection with the Panama-Pacific Exposition. As is customary in contests of this kind, many prizes, including cups, medals, cash and merchandise, will be provided. Robert E. Kerr is chairman of the committee at 625 Market St., San Francisco.

TRADE CATALOGS

Graphite for Cylinder Lubrication. Joseph Dixon Crucible Co., Jersey City, N. J. Booklet. Pp. 16. 3½x6 in. Illustrated.

Wagon and Truck Loaders. The Jeffrey Mfg. Co., Columbus, Ohio. Bulletin No. 177. Pp. 24. 6x9 in. Illustrated.

Tirrill "Equalizing" Gas Machine. Tirrill Gas Machine Lighting Co., 103 Park Ave., New York. Catalog. Pp. 16. 4x9 in. Illustrated.

Editorial Correspondence

SAN FRANCISCO—June 14

Magalia District, in Butte County, is more active than for 20 years past; not a boom, but a justifiable activity. The district, within a radius of 10 mi. of Magalia, has yielded a large amount of gold in the past and has the honor of having produced the third largest nugget in the state's history. The Willard nugget, taken from the claim at Red Hill, weighed 832 oz., Troy, and was valued at $13,312. Another weighed 132 oz., and a number of nuggets from 5 to 11 lb. in weight were also taken out of this property.

Oil Production in California fields in May amounted to 7,735,306 bbl., an average of 249,526 bbl. per day, the largest daily output recorded since January, 1915, and an increase of 3,429 bbl. a day over April. Total shipments were 8,632,074 bbl. reducing stocks at June 1, to 52,126,062 bbl. Fifty wells were completed during the month with an initial total production of 3,651 bbl. per day. There were at the end of May 6,807 producing wells: Kern River field, 1,786; Midway-Sunset, 1,545; Coalinga, 853; Los Angeles and Salt Lake, 688; Whittier-Fullerton, 587; Ventura and Newhall, 435; McKittrick, 280; Lost Hills-Belridge, 278; Lompoc and Santa Maria, 238; Summerland, 112; Watsonville, 5.

The Second Annual California First-Aid and mine-rescue field meet will be held at Sacramento, Calif., during the State Fair, on Sept. 6, 1916. The meet will be held under the auspices of the California Metal Producers' Association, assisted by the Industrial Accident Commission and the U. S. Bureau of Mines. Every effort will be made to make this meet an interesting one. Suitable prizes will be provided and as soon as the judges are selected, rules governing the contest will be sent to all teams entered, and a list of practice problems will be submitted. Entries should be sent at earliest possible date to Robert I. Kerr, secretary, California Metal Producers' Association, 1109 Merchants National Bank Building, San Francisco. No entries will be accepted after Aug. 1, except by unanimous consent of the committee.

Explosion of Missed Holes caused three of the 10 accidents reported in California mines in the first quarter of 1916. In addition to the fatalities, several men were seriously injured. This record has given Edwin Higgins, chief mine inspector, opportunity to present some interesting facts and suggestions in Bulletin 2, relating to safety and efficiency in mines, just issued by the Industrial Accident Commission. Even the brief reiteration of well-known rules would be of use to a large number of California miners. So long as mining is practised it is probable that missed holes will be fired, but the percentage of accidents from this cause may be largely reduced by a study of the literature on the subject. Bulletin 2 contains also discussion upon "Organization and Prosecution of Safety Work" and sketches of safety devices.

DENVER—June 14

Downtown Mines Co., Leadville, has finally accomplished its unwatering project and is busy in reopening old workings in the Penrose mine that have been submerged for nearly nine years. An examination of the workings of all the mines benefitted by the pumping will be made as soon as possible.

Negotiations for Merger of the Vindicator Consolidated Gold Mining Co., the Cresson, the Golden Cycle Mining and Reduction Co. and the United Gold Mines Co. are under way. Such a deal would reunite in ownership the Golden Cycle mine and mill which were separated when the Vindicator company purchased the mine. Productions of these several companies for last year are estimated at: Vindicator, $1,400,000; Golden Cycle, $1,200,000; Cresson, $750,000; United Gold Mines, $75,000. This week the Golden Cycle company has paid its dividend No. 110, being its monthly distribution of 2c. per share.

Market Price for Tungsten Ore was the chief topic discussed in a 10-day suit that terminated June 10 at Boulder. Hinman Brothers and George Retallack, lessees of a block of ground belonging to the Wolf Tongue Mining Co., at Nederland, brought suit to secure $5,500 claimed as money due them on ore produced by them and sold under contract to the company during the last quarter of 1915 when the company refused to pay more than $15 per unit notwithstanding the sharp advances in prices for tungsten ore during that period. Witnesses for the lessees had little difficulty in convincing the jury that at least a dozen competitive purchasers were paying prices higher than $15 that virtually amounted to the establishment of market quotations. The plaintiffs were given judgment for the full amount sought. An appeal to the Supreme Court will probably be taken by the defendant corporation which was shown, during the trial, to be closely associated with the Firth Sterling Steel Co. and the Washington Ordnance Co. The plaintiffs were backed by practically every leasing concern in the Nederland district.

In the Silverton District, scheelite has recently been identified in the Bismarck mine; years ago its owner, F. W. Köhler, opened up what was then supposed to be a calcite vein. Since the recent excitement over tungsten took possession of the district, Mr. Köhler decided to satisfy his wonder as to the unusual weight of his calcite by having it analyzed and thus learned of his tungstate of lime. The Ruby mine in the Silverton district is producing about 10 tons of hübnerite ore daily and this is concentrated in the Yukon mill. On the adjoining Wolframite property, lessees have opened the Ruby vein; while still farther away, on Middle Mountain, James O'Kelly has disclosed what he believes is the same vein.

BUTTE—June 15

Hoisting by Steam Power has been resumed at the High Ore mine, on account of the great demand on the compressed-air system of the Anaconda company for the Butte mines. This is the deepest of all the company mines in Butte, the shaft being down 3,600 ft. By using steam at the High Ore the air supply will be sufficient for the other mines that use air for hoisting.

The End of the Strike of the Workingmen's and the Teamsters' Union, after a duration of just two weeks, was welcomed by nearly everybody concerned. The union leaders at first declined to deal with the employers' association. Those most affected by the strike began to feel restless and with no prospects of an early settlement in sight, the Employers' Association decided that unless the union leaders would agree to discuss the demands, it would take steps to relieve the situation without the coöperation of the unions. It was at this point that the more conservative members of the unions urged a conference with the association and as a result all workers have returned to their respective jobs at the wages in force before the strike. It was agreed to discuss, at a future meeting, means to stop landlords from raising rents and dealers from increasing the cost of necessities beyond reasonable amounts.

Rumors of a Further Consolidation of mining interests in Butte are persistent, the latest being that the Anaconda company is likely to take over the Davis-Daly and the North Butte. It is also in the rumor that the Greene-Cananea may be turned over to the Anaconda company. At the time of the general consolidation in Butte, by which the Anaconda company took over the Boston & Montana, Butte & Boston, Colorado, Parrot, and later the Heinze properties, the North Butte was excluded because that company was incorporated under the laws of the State of Minnesota which required the unanimous consent of shareholders for a sale of their properties. Since then the laws of that state have been changed so that a majority of the stockholders can dispose of their properties. It has been surmised that the law of that state has been changed to permit the sale of the North Butte and the Greene-Cananea, the latter also being incorporated under the laws of Minnesota. The Tuolumne mine, it is rumored, will be taken over either by the North Butte or the Anaconda company. Tuolumne lies between Anaconda and North Butte. With the purchase of North Butte and Tuolumne, the Anaconda company would own Anaconda Hill, with the exception of the two claims of the Elm Orlu and the Butte & Superior.

Activity in Eastern Section of Butte District is marked and the Northern Pacific management is considering the extension of a spur from its present tracks at the Pittsmont mine to the Tropic and other properties that are now without railroad facilities. Plans for development at the Butte & Main Range, the Colusa-Leonard Extension, the Butte & London and the Bullwhacker, will make such a spur a necessity. About 200 tons of ore a day are being hauled from the Anaconda company's Tropic mine to the nearest railroad spur at a cost of 40c. a ton. The Bullwhacker also has to haul its ore by team and so will the Butte & Main Range which has just been taken over by the Tuolumne company. At the latter

property, shaft will be sunk from its present depth of 700 ft. to the 1,000-ft. level where crosscuts will be run both ways to explore the property. At the Colusa-Leonard Extension, the shaft is 825 ft. deep and the Tuolumne company plans to sink to the 1,600-ft. level and crosscut. At the Butte & London property everything is ready for further development by crosscutting at the bottom of the 1,600-ft. shaft.

The Butte & Ely Copper Co. had a somewhat stormy annual meeting on June 5, when the minority stockholders made a strenuous but unsuccessful effort to force the management to begin operations on the property which adjoins the Nevada Consolidated at Ely, Nev. The minority representatives, however, had only 81,000 shares of stock, while the majority, represented by Attorney J. W. Neukom, held 410,000 shares. Joseph B. Cotton, J. W. Neukom, John D. Pope and E. A. Maney were elected directors for the ensuing year. The minority put in nomination for directors Fred Melcher, C. W. Goodale, J. L. Carroll, Malcolm Gillis and Ben Calkins, five well-known Butte men connected with prominent mining enterprises here. The minority demanded that the management bring action to collect the $100,000 loan and $6,000 back interest from the Giroux company; also demanded some action on the management's promise to begin mining when the price of copper reached 15c. A motion offered by C. W. Goodale calling on the management to submit a report of the ore reserves was also defeated. The objecting stockholders were invited to remain at the meeting of the board of directors at which a resolution was adopted demanding the payment of the $6,000 interest due from the Giroux company but nothing was done about demanding the principal of the loan. General Manager E. F. Gray reported that no mining had been done as the proposed agreement with the Nevada Consolidated had not been consummated because the Nevada company has been carrying on its mining operations between the Eureka and Liberty pits and had not found it necessary to enlarge its pit area during the year.

WALLACE, IDAHO—June 14

An Electrolytic Zinc Plant may be erected on the Spokane River a short distance below Spokane where 20,000 hp. is available. For several weeks a representative of a syndicate, composed both of Western and Eastern men, has made a careful investigation of the present production of zinc in the Cœur d'Alene district and a close estimate of the probable production within the next 18 months. His conclusion is that by the end of the period stated this district will be turning out approximately 850 tons of shipping ore and concentrates per day. The success of the Anaconda company in the electrolytic treatment of zinc ore, and particularly its success in handling the complex ore of the Douglas mine, which the company is now developing in Pine Creek section of the Cœur d'Alene district, is certain to bring about a radical change in the manner and place of treatment of zinc ores in the northwest. At present all the zinc ore from this district goes to Kansas, Oklahoma and Eastern smelteries, which have the advantage of natural gas or cheap fuel. It is understood that the Anaconda company's new plant at Great Falls, Mont., will have little, if any, more capacity than will be required for the product of its own mines. The promoters of the proposed plant on the Spokane River figure that with the splendid water power they hold and the advantage of a low freight rate from the mines, probably $1 or $1.50 per ton, they will be able to compete successfully with the distant Eastern smelters who are limited to the old processes in the absence of cheap water power.

SALT LAKE CITY—June 16

Electrification of the Bingham & Garfield Ry. is under consideration, though no appropriation for the work has yet been made. This railroad, being a subsidiary of Utah Copper Co., transports most of the Bingham Cañon production that goes to Garfield.

The U. S. Geological Survey is taking steps toward making the much desired survey of the Cottonwood and American Fork mining district, although the sundry civil bill upon which this work is dependent has not yet been passed. Meantime, B. S. Butler and F. F. Hintze, of the Survey are in this city, and will in a few days leave for the district.

The Utah Ore Sampling Co. is to erect another plant at Murray to take care of increased shipments. The new plant will be close to the old one. At present the sampler is handling an average of 500 tons a day. The new plant on which work will be started in the near future is intended to double the capacity. The addition should prove of interest to shippers because it will cut down much waiting for cars to take their turn in sampling, as at present. At Silver City the sampler is running nearly at capacity, having handled a greatly increased tonnage since shipments from Tintic have been heavier. The Park City sampler of this company is also in active operation. The three samplers together are handling the largest tonnage in the history of the company. These are the only important custom sampling mills in Utah, though sampling facilities also exist at all the smelting plants.

EL PASO, TEX—June 15

The Arizona Smelting Situation is becoming serious. Many small shippers who have not contracts with the smelters are being forced to close down or curtail their operations on account of the smelters not being able to handle the ores. There have been cases where men have bought or leased properties and had their first shipments turned down. In some instances shipments have merely been limited, but in others all new ores are refused, owing to the inability on the part of the smelters to handle larger tonnages until certain extensions have been made. Most of the smelters have long-standing contracts with the more prominent producers; the latter have greatly increased their output within the last year, besides which there has been a general increase in the amount of custom ore offered. The smelters, however, are doing everything possible to take care of the increase in business. The smelteries at Hayden, Miami and Douglas are all making extensions and the El Paso smeltery will put into operation five old lead furnaces as soon as they are sufficiently repaired. The old Sasco smeltery has been purchased by the American Smelting and Refining Co. and blown in. Efforts are being made to revive the old Pioneer plant at Sahuarita, and the smeltery at the Swansea mine in Yuma County. There is talk of a custom plant at Prescott and of a custom lead stack at Wickenburg. The latter is particularly needed as there are no lead-smelting plants nearer than El Paso, and the Needles where capacity is limited.

VIRGINIA, MINN.—June 16

I. W. W. Representatives have been organizing the miners of the Virginia district for the past week and claim to have several hundred already enrolled. The miners of the Miller and the St. James mines at Aurora, on the eastern Mesabi, went out on strike two weeks ago, but some of them have returned to their places. W. D. Haywood, secretary-treasurer of the Industrial Workers of the World, who was formerly connected with the Western Federation of Miners, and W. D. Scarlet, of Chicago, who was prominent in the Paterson, N. J., strike two years ago, have assumed charge of I. W. W. affairs on the range. The striking miners of the Aurora district marched to Eveleth, Gilbert and Virginia enlisting recruits. There was a little trouble at the Genoa mine, of the Oliver Iron Mining Co., but no serious violence resulted. None of the miners there joined the union. The strike leaders claim that they will soon have every mine in the Virginia district shut up tight, but the mine officials state that this will not be the case. All of the mines here are still operating, although many of the miners have left their work. Fearing that there might be violence, all of the saloons of Virginia were closed by orders of the city commission. There are no saloons in Hibbing, Chisholm and some of the smaller towns, having been put out of business when an old Indian treaty was enforced this year. The strike leaders have been asked to leave the city but they have refused to depart. A mass meeting of about 1,000 citizens was held in Virginia, Friday night, and the police will be given every support if trouble is started. The demands of the men who are striking are as follows: (1) A scale of $3.50 for work underground in wet places, $3 in dry places and $2.75 on surface; (2) an 8-hr. working day, miners to enter and leave the mine on company time; (3) semimonthly paydays; (4) immediate payment when miner quits; (5) abolishing Saturday night shift in mines where it has not been discontinued, the miners to be paid for the shift; (6) abolishing overtime work, or payment at double prices for overtime. The miners throughout the entire Lake Superior district were granted an 8-hr. day several years ago, but it is not from "collar to collar," the miners going to and from their places from the collar on their own time.

(Later)—Mesabi Range strike has become more serious All underground mines in Biwabik and Aurora are idle. Most of those in Virginia, Gilbert and Eveleth are closed or working with small forces. Operators may decide to close all underground mines in district.

JOPLIN—June 17

Production Above Normal is again being recorded in this district, after two weeks of curtailed output on account of refusal of the Brotherhood of Hoister Engineers to abide by a 50c. cut in wages the first of June. While a number of the striking hoistermen are still out, their places have been filled at virtually all the mines. The sheet-ground mines in the North Webb City section, which were down for a week and a half, are all operating again, with new hoistermen. Mine managers state they are not getting quite so good a tonnage as with the old hoistermen, but believe they will be soon.

The Mining News

ALASKA

GRANBY (Hadley)—Boyle Bros., of Spokane, are diamond-drilling here for the Granby company.

B. L. THANE DEVELOPMENT CO. (Juneau)—Organized by B. L. Thane, manager of Alaska Gastineau, to develop Alaskan and Canadian properties.

ALASKA-ENDICOTT MINING AND MILLING CO. (Juneau)—E. M. Aldrich, of Spokane, is directing summer work at property on Endicott Arm, Berner's Bay region.

McKINLEY LAKE (Cordova)—George C. Hazelet has bonded this quartz property for Eastern men; engineer will examine this summer. Claims situated 18 mi. from Cordova and 3 mi. from Copper River & Northwestern Ry.

ARIZONA

Cochise County

KILMURRY-MORGAN (Bowie)—An 8-ft. orebody disclosed by shaft now down 121 ft.

FLUORINE (Pearce)—C. A. P. Brown and associates bonded this mine for $135,000 from William Mitchel.

BOWIE MINES DEVELOPMENT CO. (Bowie)—New company may build 50-ton mill on old Buckeye silver-lead mine.

BLACK PRINCE (Johnson)—New 100-hp. boiler in place and stations cut for three new pumps to handle water from ninth level.

APACHE PASS GOLD MINING CO. (Bowie)—Incorporated to develop old Quillian mine, comprising 18 claims and having two-stamp mill. Free-milling gold ore, but silver-lead ore carrying gold recently opened in new tunnel. J. H. Jaque, secretary.

Gila County

INTERNATIONAL (Miami)—Adding third reverberatory.

MIAMI MOTHER LODE MINING CO. (Miami)—Incorporated to acquire Mother Lode Extension, Five Points and William Schafer copper groups, 1,140 acres. William Schafer, manager.

OLD DOMINION (Globe)—Pumping 6,500,000 gal. water per day; lowest in a year. Increase of production to 3,400,000 lb. copper per month by having flotation concentrates treated in reverberatories at International smeltery. Favorable developments at depth in Old Dominion, and in United Globe mine, at 1,600 level, high-grade ore was recently disclosed.

Maricopa County

MORMON GIRL (Cave Creek)—Resumed development; several shipments made.

H. K. PATCH (Peoria)—Taking out high-grade tungsten ore from claims purchased from Butler and Martin.

MAX-DELTA (Phœnix)—Developing gold property south of Phœnix; W. S. Jennings, superintendent; 12 men employed.

GARDINER & NESS (Peoria)—Making preparations to install concentrator on tungsten property on Tule Creek. Ore carries tantalum also.

JOHN ASHER (Peoria)—Shipping high-grade lead-silver ore; sorting out molybdenum and vanadium ore also for shipment to Los Angeles, Calif., where it will be treated.

Mohave County

ARGO (Oatman)—Shaft reached 555 ft. in 80 days' sinking; being continued to 600 level.

GILT EDGE (Oatman)—Shaft at 300 ft.; water encountered; pump ordered from Denver.

OATMAN PIONEER (Oatman)—Good ore reported in south drift at 400-ft. level. E. H. Dawson, manager.

OATMAN BELL (Oatman)—Machinery installed and shaft down 60 ft. Lester M. Dull, of Colorado, interested.

BLACK RANGE (Oatman)—Six feet of ore opened on 300-ft. level. Pump now installed will prevent further delay from water.

OATMAN GOLD GROUP MINES CO. (Oatman)—Incorporated by C. H. Shoemaker and Philadelphia men to develop group in the Times section.

OATMAN UNITED (Oatman)—Shaft down 110 ft. with temporary hoist. New headframe being wired for electricity to be used with new hoist.

TOM REED (Oatman)—Reported discovery of rich ore on 1,400-ft. level, the deepest working in the mine and district; vein width said to be 12 ft.

ARIZONA CENTRAL (Oatman)—Charles E. Knox, of Tonopah, and Eastern men are developing this property, adjoining United Eastern. Shaft down 100 ft.

BIG JIM (Oatman)—On 485 level, face of east drift in fine ore. Sinking to 600 ft. being considered. Jafet Lindeberg, of San Francisco and Alaska, has taken important interest.

ARIZONA-BUTTE MINES CO. (Kingman)—Building mill to treat zinc-lead-gold-silver ore of the Banner and other Stockton Hill mines in Cerbat Mountains. Mill equipment includes Blake crusher, Denver rolls, Huntington mill, 7 Butchart and 3 Wilfley tables, Steffy pulsating screens, Delano deslimers, and 75-hp. gasoline engine. F. E. Steffy, mill constructor. Henry M. Crowther, manager.

Pima County

IMPERIAL COPPER CO. (Redrock)—Court awarded flue dust and old slag at Sasco smeltery to company, rejecting claims of creditors of Southern Arizona Smelting Co. Both corporations bankrupt.

GOULD (Tucson)—Optioned by American Smelting and Refining Co. to secure flux for Sasco smeltery. Same company reported to have optioned Copper Mountain group, 18 mi. south of Ajo.

Yavapai County

STAR (Walker)—W. L. Comer has resumed development; shaft down 100 ft., in 3-ft. body $15 ore.

DUNDEE-ARIZONA (Jerome)—New hoist and compressor installed. Shaft now 200 ft.; will be continued to 900 ft.

HOMESTEAD (Walker)—Recently purchased by New York syndicate from Mrs. M. A. Milliken. Hoist and other machinery being placed.

TUNGSTEN KING MINING (Crown King)—Struck 2-ft. vein of high-grade ore in Davis group, Tule Creek district; N. H. Getchell president.

WHITE HORSE (Mayer)—Mine in Black Cañon district, sold to Willard Bondurant, of Los Angeles. Deep development will be undertaken.

KEYSTONE (Prescott)—San Francisco operators negotiating for purchase of Dos Oris, Raven, Buzzard, and Mark Twain claim on Hassayampa river.

WHITE SPAR (Prescott)—Sold to A. E. Moynahan, formerly mine inspector of Colorado; arranging for immediate operations. Property on Hassayampa River.

JEROME VERDE (Jerome)—Columbia shaft being enlarged to three compartments and deepened; 112-hp. hoist and 700-cu.ft. compressor installed. J. B. Harper, superintendent.

OLD YORK (Yarnell)—Sold to San Francisco men; new hoist, compressor and other equipment ordered; several buildings going up; large force will soon be put to work at this gold mine; has 400-ft. shaft.

CLIMAX (Prescott)—Lens of telluride ore, running as high as $600 gold, has been cut. Company has also taken over old Catoctin group of mines on Hassayampa River; will unwater and install new hoist.

CALIFORNIA

Amador County

SUTTER CREEK MINING CO. (Sutter Creek)—Unwatering old Poundstone mine on East belt, 1 mi. from Sutter Creek; reopening old shaft north of main shaft.

WILDMAN-MAHONEY-LINCOLN (Sutter Creek)—Reported option on these properties, believed to be in the interests of Consolidated Amador Mining Co. which owns Old Eureka.

CONSOLIDATED AMADOR (Sutter Creek)—Transformers installed, hoist and compressor connected, pumps connected to motors but initial unwatering shaft will proceed with baler.

SOUTH EUREKA (Sutter Creek)—Ten stamps of Oneida mill dropping on ore from lower workings of Oneida. Large ore reserves opened east of main South Eureka workings. Eighty stamps dropping on South Eureka ore. W. H. Schmal, superintendent.

Butte County

MANGANESE DEPOSITS at Clipper Mills being mined by Noble Electric Steel Co.; 2 motor trucks hauling ore to Oroville.

SMITH-UNDERSTOCK (Quartz)—On west branch of Butte Creek, rich ore found at end of 120-ft. crosscut. Title dispute on at present.

ZENITH CHROME MINING CO. (Forbestown)—New deposit of chrome being worked. Reported that company employs 5 motor trucks hauling ore to Oroville. Company has purchased another chrome deposit near Swayne.

EL ORO DREDGING CO. (San Francisco)—Prospected gravel on Butte Creek, near Chico, adjoining Pacific Gold Dredging Co. Area about 336 acres and includes the lands of McLaughlin, Beck, Polk, Perley and Crouch. Charles F. Helman, manager.

Calaveras County

GOLD CLIFF (Angels Camp)—Reported rich strike made on 1,600 level. New drift is being opened on 1,800 level. F. J. Martin, superintendent.

CALAVERAS MINING CO. (Angels Camp)—New 75-hp. electric motor will be installed for air compressor. Extensive development in progress.

Eldorado County

WOODLAWN (Eldorado)—New owners will reopen.

CHURCH UNION (Eldorado)—Preparations being made for resumption by San Francisco purchasers.

MONTEZUMA (Placerville)—New vertical shaft has reached 830 ft. Drifting on the 500 and 800 levels in progress. On the 500, large orebodies reported, averaging about $5 per ton. Vein on 800 is ribbon quartz on the foot-wall side, running about $10 per ton; white quartz on hanging-wall side is low grade. Property owned by J. C. Heald and being developed by California Exploration Co. under direction Albert Burch, of San Francisco. Mill may be installed.

Inyo County

CUSTER (Darwin)—Shipping some high-grade copper ore, though its main workings are in lead-silver zone of Darwin district. Installing new hoist and compressor.

Kern County

POTASH NEAR KANE SPRINGS reported; a number of claims have been located by Randsburg men.

GARLOCK-GOLER district is again active. Old tunnel reopened by Maples, Biddle and Weaver who encountered large quartz vein carying some ore assaying $56 per ton in gold, silver and copper; expect to ship 30 tons to Selby. Reported strike caused small rush to district. In this region, about 20 years ago, much placer gold was recovered. Camps were deserted when the Yellow Aster at Randsburg was discovered.

Nevada County

IRELAN (Nevada City)—Strike of high-grade ore in this property attracting attention of prospectors to Alleghany district. Ore contains arsenical sulphurets.

CALIFORNIA (Spenceville)—This copper mine being reopened by Partridge and Johnson, of San Francisco. Martin Rourke is manager.

San Bernardino County

TUNGSTEN MINING is still active notwithstanding decrease in price of the ore. Several important discoveries have been made recently in area between Atolia and Randsburg. Tungsten belt extended to 10 mi. east and west of Atolia and 5 mi. north and south. Atolia Mining Co. curtailed production but total output of independent producers amounts to more than 100 tons a day.

Shasta County

HEROULT SMELTERY reported to have resumed smelting of ferro-manganese ores. Supply of manganese temporarily curtailed, during which period iron ore from Heroult mines kept plant going. Fifteen carloads of iron shipped East.

MAMMOTH (Kennett)—Reported that purchase of Stowell group has been completed for $96,000, which included $13,000 delinquent tax claims.

Tuolumne County

DUTCH-SWEENEY-APP (Jamestown)—High-grade ore disclosed in the Dutch, following closely upon recent strike in the App. Mill treating over 200 tons per day.

BACIGALUPI (Jamestown)—Taken by Pittsburg Silver Peak Mining Co. on bond. James Diamond and H. C. Garner, former owners, and Robert Pierson who promoted the deal retain interest. Development being done under contract by Barney Whitaker and others. John Mocine, superintendent.

COLORADO

Clear Creek County

BOLTHOFF (Dumont)—Ground being broken for 25-ton mill, following tests.

NEW ERA (Freeland)—Being developed under lease by W. A. Gilman. Mill in operation.

HUMBOLDT (Idaho Springs)—This Ute Creek property will be reopened by the owner, John R. Wallace.

CONCRETE (Idaho Springs)—The crosscut has been completed and a west heading is being advanced on the vein. A connection will be made with the bottom of the Concrete shaft.

EDGAR (Idaho Springs)—Being developed by Nankervis and associates of Idaho Springs. Vein opened by Big Five tunnel 2,800 ft. from portal. West heading advanced 280 ft. is in milling ore tested recently in Newton mill producing concentrates worth about $60 a ton. Pockets of smelting ore also opened.

LAKE (Idaho Springs)—Being developed below the Big Five tunnel level by I. D. L. Leasing Co. of which George K. Kimball is manager. Block of ground below old Moser and Kline lease being opened at two levels with favorable results; vein 2 to 3 ft. wide and averages about $15 a ton. Shaft will be sunk an additional 100 ft. and a new skip installed to replace bucket.

Gunnison County

VULCAN MINES AND SMELTER CO. (Vulcan)—Controls Vulcan, Good Hope and Mammoth Chimney mines, southwest of Gunnison City. Vulcan shaft repaired and water now lowered to 500-ft. level. Shaft is 700 ft. deep. Small copper-matting furnace installed recently to treat dump ore and later, mine ore. Auto truck will be used for hauling.

Lake County

WESTERN ZINC MINING AND REDUCING CO. (Leadville)—Preparing foundations for four more zinc-oxide furnaces; eight in present battery.

San Juan County

SILVER LAKE (Silverton)—Two kinds of ore now mined by lessees, sulphide ore carrying copper and lead, and gold quartz ore. Underground development will be pushed vigorously during summer.

San Miguel County

SHIPMENTS FROM TELLURIDE for May amounted to 120 cars; principal shippers were: Tomboy, 58 cars; Smuggler-Union, 67 cars; Liberty Bell, 11; Columbia Leasing, 4 cars.

SANTA CRUZ (Ophir)—Being developed by Wichmann and Myers. Test shipments made to Salida.

IMES (Sawpit)—Recent development highly encouraging. Gold-silver-lead-zinc vein 2 to 4 ft. wide, assaying from $40 to $60.

Teller County

ROOSEVELT DRAINAGE TUNNEL flow was 14,065 gal. per min. on June 4.

ELKTON (Elkton)—Overwinding caused death of Roy North and serious injury of another miner on June 8.

ALBERT-BEACON GOLD MINING CO. (Cripple Creek)—Incorporated to work Prince Albert mine on Beacon Hill. Frank Vetter, president and manager.

GOLD SOVEREIGN (Cripple Creek)—On 1,400 level, Union Leasing Co. has shipped $30 ore from recent strike. William Reed, lessee, has completed mill for treating the dump.

NEW ERA LEASING CO. (Cripple Creek)—Formed by James F. Burns to work Minnehaha claim of Jennie Sample company. Old drifts above 750-ft. level will be extended. Edward P. Arthur, Jr., superintendent.

IDAHO

Blaine County

EL ORO (Soldier)—Operations resumed at this mine and mill. Charles W. Smith, manager.

Shoshone County

NORTHERN LIGHT (Kellogg)—Shaft sunk on this Pine Creek property to 400 ft.; crosscut being run to two veins opened on the 200 level.

CONSOLIDATED MARSH MINES CO. (Burke)—To be organized to acquire Marsh Mining Co., the Green Mountain now controlled by Marsh, and perhaps some additional properties. Marsh's new executive committee is W. M. Lee, of Duluth, Edward Pohlman, of Spokane, and W. Earl Greenough, of Wallace. New company will have 2,000,000 shares, $1 par; old company has 1,450,000 shares outstanding. Share for share exchange; remainder to be offered to shareholders first, then to underwriting syndicate.

STEWART (Kellogg)—Stockholders will meet in Kellogg on July 8 to consider increasing capital stock from 1,250,000 shares to 3,000,000. Additional stock to be used for acquisition of new mining property; two properties favorably reported on by company's engineers. Stewart mine practically exhausted. Operations now limited to the Coeur d'Alene Development Co., control of which was recently secured; adjoins the Stewart. About 50 tons of ore per day being produced, concentrated under contract at Sweeney mill.

MICHIGAN

Copper

TAMARACK (Calumet)—Ore production last month was over 40,000 tons; increase of 3,000 tons.

FRANKLIN (Demmon)—Made remarkable increase in tonnage in May, increasing by 154 cars to 553 cars of ore.

OSCEOLA CONSOLIDATED (Osceola)—Production from Kearsarge end of mine showing slight increase furnishing 2,318 cars in May; tonnage from old Osceola about average.

Iron

ATHENS (Negaunee)—Shaft down over 1,600 ft. First station will be cut at 1,850 ft. Shaft will be sunk to 2,600 ft.; will be deepest vertical iron-mine shaft in the country. Ore struck unexpectedly in shaft at about 1,550 ft. Over 500 tons of ore from shaft now in stock. Sinking at rate of 120 ft. per month. Cage being used in place of buckets. Shaft is circular to the depth of 1,000 ft. and concreted to that point; below it is rectangular and will be concreted later. Steel bearers being put in every 100 ft., and 10 ft. of concrete on each side. This will aid concreting later; concrete will be poured from a number of points and there will be no delays waiting for concrete to set. Shaft should be bottomed about first of year.

MINNESOTA

Mesabi Range

BRUNT (Mountain Iron)—A duplex Bury air compressor, capacity 300 cu.ft. per min., will be installed.

SHERIDAN (Hibbing)—Stripping operations nearing completion after two years' work. Overburden dumped into Carson Lake, drained for the purpose. Stripping will probably be completed by Sept. 1 and some ore moved this season.

MISSOURI

Joplin District

EVANS-HALL-SOY (Duenweg)—New mill started on Orr land. Steam-driven plant; sludge department.

TRENT (Granby)—Drilling campaign shows sheet-ground orebody from 250 to 278 ft. Lease owners, Underwood & Benintendi, will erect large mill.

BARRETT (Duenweg)—Jones & Gipson erecting 500-ton mill on recently prospected tract. Sludge unit operated by separate engine. Concrete base for all machinery.

RAMAGE (Joplin)—Mine No. 6 in West Joplin camp is closed for improvements, including Dorr thickener, sand jig, Henry screen and five more sludge tables. Now have 15 tables.

GOTHAM (Prosperity)—Now producing from old Carnation lease. New steam-driven mill with built-in sludge department. Soft-ground formation at 200 ft. and sheet-ground at 215 ft. being worked.

ROLLAMO (Webb City)—Tailing mill recently produced 18 tons concentrates in 24 hr.; district's record for tailing plant. Handling 1,200 tons daily in three 8-hr. shifts. May install 10 more tables.

MASCOT (Granby)—Sold by Underwood & Benintendi to American Zinc, Lead and Smelting Co. for $55,000. Consists of 68-acre lease and concentrating plant, near Granby properties recently taken over. Steady producer for number of years.

MONTANA

Beaverhead County

BANNACK (Bannack)—Employing 50 men in development and shaft sinking. Another crew of 20 men will complete 40-ton mill. Unoptioned portion of Golden Leaf group being worked by Mr. Dunn, original owner.

Fergus County

BARNES KING (Butte)—Reports ore mined in May at North Moccasin mine was 3,779 tons yielding $28,000 bullion; yield per ton $7.41, an increase of $1.04 over April. Piegan Gloster produced 2,178 tons in May; bullion $10,000; yield per ton, $4.09 Week's shut-down announced for repairs at both mines. Shannon mine ready for stoping. Aërial tramway from mine to Piegan Gloster mill under construction.

Granite County

BROOKLYN (Maxville)—Important strike at this old copper-silver mine in crosscut at vertical depth 280 ft. Vein is 6 ft. wide. About 30 tons being extracted daily in course of development. About six months ago property was taken over by Spokane, Wash., men; 100-ton mill will soon be ready.

Jefferson County

IN MONTANA CITY DISTRICT, a few miles south of Helena, John Stevenson has bonded copper-silver-gold property to Vancouver men. Vein 7 ft. wide, $12 to $14 per ton, ore on dump. Leasers may erect small mill.

MOOSE MOUNTAIN COPPER CO. (Corbin)—Three high-grade copper-lead-zinc-silver veins being developed; tunnel in 1,400 ft.

Lewis and Clark County

SUNSHINE (Helena)—Owned by principal stockholders of Scratch Gravel Mining Co.; shaft being sunk. Plans to begin shipping copper-gold ore immediately and to install machinery.

SCRATCH GRAVEL MINING CO. (Helena) — President Cullen announces shipments from now on will net at least $30,000 per month; about 2,000 tons have been shipped to East Helena smeltery, netting on average $2,300 for 40-ton car. Most of this ore came from development work.

Phillips County

BEAVER CREEK MINING CO. (Butte)—Syndicate of Butte men, headed by J. L. Bruce, of Butte & Superior company, acquired control of this property in Little Rocky district, near southern edge of Fort Belknap Indian reservation. Low-grade gold deposit, developed by 1,400 ft. of tunnels and drifts; winze recently opened $6 rock. Equipped with 300-ton cyanide plant. It is said that 200,000 tons of $4 ore blocked out. Syndicate to add new mill equipment costing $50,000.

Silver Bow County

EAST BUTTE EXTENSION (Butte)—On 250 level, No. 6 shaft, 2½-ft. vein opened by leasers.

EAST BUTTE (Butte)—May production, 1,517,440 lb. copper. Nearly 20,000 tons of ore is being hoisted per month.

BUTTE & GREAT FALLS (Butte)—Crosscut on 500 level has not yet reached Genevieve vein. Drifting in V. G. vein showing good orebody.

ANACONDA (Butte)—Will increase output at its Butte mines about 30,000 tons a month by putting on four additional shifts per month. Mines will operate on Sunday nights as well as Saturday nights. Up to now company has been running mines only 26 days out of 30 each month, a plan that was outgrowth of curtailment two years ago. New plan will increase copper production 2,000,000 to 3,000,000 lb. per month.

NEVADA

Clark County

INGOMAR (Goodsprings)—Lakeview Mining Co., Samuel S. Arentz, manager, has bond on this claim situated high on limestone cliffs; ore typical zinc carbonate of section is sent through 500 ft. of No. 16 11-in. pipe at angle of 45° to platform and chute where it is loaded on burros and packed 1,000 ft. to road; then hauled by tractors to Roach, Nev. Can produce steadily while zinc price is high.

Elko County

DELANO (Contact)—Employing 30 men and shipping three cars copper ore per week. Heavier equipment to be added and production increased.

RUBY FRANKLIN MINES CO. (Tobar)—This new company will operate group of eight zinc claims, 15 mi. from Tobar. A. L. Hansen, 1119 Boston Bldg., Salt Lake City, Utah, secretary.

Esmeralda County

BUTTE GOLDFIELD (Goldfield)—Hargrove & Cormack lease recently shipped car of lead-silver ore, averaging $35 per ton, from this property at Gold Mountain.

RAY (Goldfield)—Carload of machinery, including hoist, compressor, etc., being hauled to these copper claims. Developments encouraging. Shaft down 200 ft.; 15 men employed.

JUMBO EXTENSION (Goldfield)—May profit amounted to $31,250. Production was 2,850 dry tons, gross value $91,500. Sampling, freight and treatment costs were $32,250; smelter loss, $10,500; operating expense, $17,500.

Humboldt County

BULL CON CAROLINE (Golconda)—Shipping two cars per week. Ore averages about 5% copper.

RYE PATCH (Rye Patch)—Consolidation of old Alpha and Silver Bell properties. Sulphide zone will be prospected by diamond drilling.

SEVEN TROUGHS COALITION (Seven Troughs)—For year ended Apr. 30, 1916: Ore returns amounted to $335,735; direct operating expense, $214,561; administrative and general expense, $26,574; profit. $98,977.

Lincoln County

PIOCHE ORE SHIPMENTS for fortnight ended June 10 were approximately 9,000 tons from six properties, although about nine-tenths of tonnage was from Prince Consolidated.

Mineral County

LUNING ORE SHIPMENTS from 14 properties, now operating in district, average 100 tons daily, the majority carrying from 4% to 6% copper.

Nye County

TONOPAH ORE SHIPMENTS for week ended June 10 amounted to 9,217 tons, valued at $185,766, compared with 8,778 tons for week previous. Producers were: Tonopah Belmont, 2,802 tons; Tonopah Mining, 2,550; Tonopah Extension, 1,850; Jim Butler, 750; West End, 630; Rescue-Eula, 210; Halifax, 160; North Star, 55; miscellaneous, 210 tons.

MACNAMARA (Tonopah)—Stoping suspended pending connection with Red Plume workings of Tonopah Mining Co. for better ventilation.

BLACK MAMMOTH (Manhattan)—Under bond to Record Lode Mining Co. Incline shaft now down to 100-ft. level with 2½-ft. ore showing.

ROUND MOUNTAIN (Round Mountain)—With additional water recently acquired, both the Jet Creek and Jefferson-Shoshone lines are sluicing three shifts. Returns to date indicate profitable season.

Storey County

SIERRA NEVADA (Virginia)—On 2,400 level continued reopening east crosscut; on 2,500 level saved 67 tons, $17.74.

MEXICAN (Virginia)—On 2,500 level north drift advanced to 61-ft. point, face in porphyry and quartz of low assay. Mexican mill crushed 456 tons custom ore, average $38.39.

COMSTOCK PUMPING ASSOCIATION (Virginia)—Sierra Nevada, Mexican and Union shaft repaired to 115-ft. point below 2,500 level. C & C shaft preparing to put in new pump-discharge column below 2,000 level.

UNION CON (Virginia)—Ore extraction, 389 tons. From 2,400 level 86 tons, $42.45; 195 tons, $48.75; from 2,500 level 108 tons, $19.24. On 2,700 level north drift advanced to 46-ft. point, face in porphyry and quartz.

CROWN POINT-BELCHER (Gold Hill)—Work continued on 300 level, 16 cars of ore saved; no work below that level on account of gas from recent fire. Jacket mill ran 4 days on dump rock, received 389 tons, shipped bullion.

OPHIR (Virginia)—Cleaned out west crosscut on 2,400 level 20 ft.; started and advanced 10 ft. on northwest drift; 12 in. quartz in face, assaying $8 to $20. On 2,500 level main north lateral drift repaired 110 ft. to 830-ft. point; on 2,700 level, north drift extended 17 ft. to 32-ft. point, face in quartz.

NEW MEXICO

RATE ON ZINC SHIPMENTS not exceeding $50 per ton in value from Magdalena to East St. Louis, $5.75 per ton. Excess collected by Santa Fé Ry. from Granby Mining and Smelting Co. in November, 1915, ordered returned by Interstate Commerce Commission.

Grant County

C. & O. M. & R. (Pinos Altos)—Shipping lead-zinc concentrate, containing some gold and silver.

MILLS (Pinos Altos)—New headframe built; shaft retimbered; 16-in. streak ore on 100-ft. level carries gold, silver and zinc.

CHINO (Hurley)—Estimated May production, 6,491,000 lb. copper. Mill treating 2,000 tons per day more than average of last year, or over 9,000 tons daily.

Otero County

LA LUZ, a new gold camp, is attracting attention. Tungsten and copper have also been found.

GARNET (Jarilla)—Sold to William Möller and O. D. Warnock, of El Paso; will develop.

IRON KING (Jarilla)—J. H. Parker and Winchester Cooley, leasers, will resume and will ship daily about 15 carloads high-grade iron ore to Colorado Fuel and Iron Co., Pueblo, Colo.

Sierra County

BRUSH HEAP (Kingston)—Work resumed under management of John Moffitt, of El Paso.

ERNESTINE (Mogollon)—Installation of large, double-drum, electric hoist completed. Skips now used.

EBERLE (Mogollon)—Being developed by the Oaks Co., Alma, N. M. Last shipment, 46 tons, averaging $17.

ROSEDALE GOLD (Rosedale)—Operations will be resumed and mill rebuilt; J. P. Norvelle, of Terre Haute, Ind., owner.

MINTOE SILVER-LEAD MINING (Hermosa)—Lead ore, running 60 to 70 oz. silver to ton, opened; five carloads already on dump.

OREGON

Grant County

COMPTON MINES CO. (Susanville)—Platinum reported in this gold-silver mine. The 140-ft. shaft and 175-ft. drift showed good gold and silver assays; tunnel started to cut vein 400 ft. below shaft bottom disclosed blind lead that gave assay of $4.40 gold and 1.10 oz. platinum. O. H. Bennett, Wallace, Idaho, president.

Josephine County

ANDERSON (Kerby)—This placer averaging $1,000 in gold and platinum every 20 days.

WALDO (Waldo)—Many improvements made; preparing for extensive working of this placer during coming season.

CALIFORNIA MANGANESE company is gathering chromic iron ore from eight prospecting camps in hills surrounding Kerby. Ore is hauled 17 mi. in auto-trucks to railroad at Waters Creek. More than 1,000 tons ready for shipment. Chrome output of Josephine County for 1916 will exceed all previous records.

PENNSYLVANIA

CAMBRIA STEEL (Johnstown)—As soon as new blast furnace at Franklin department is complete, two new openhearth furnaces will be erected; cost about $200,000; will add 300 tons of steel to the present daily capacity of about 2,700 tons. More furnaces planned at the lower Cambria mills.

TENNESSEE

CHATATA ZINC MINING AND MILLING CO. (Charleston)—Contemplates erecting mill at old lead-zinc mine of the Asheville company. Incline shaft, 280 ft., in ore. C. M. Streckler, 524 St. James Bldg., Chattanooga, Tenn., manager.

UTAH

Beaver County

BEAVER COPPER (Milford)—Shaft sinking being done on low-grade ore.

BEAVER LAKE METALS (Milford)—Two drills at work sinking shaft to 100-ft. level.

SOUTH UTAH (Newhouse)—Leasing company understood to be making profit. Possible that flotation may make the mine profitable.

Iron County

A CAR OF HEMATITE from the Iron Mountain deposits shipped East for experimental purposes. The deposits at Iron Springs and south contain immense tonnage of hematite and magnetite; utilization only a question of time. There are coal deposits in Parowan range, 12 mi. east. The nearest railroad point at present is over 20 mi.

Piute County

INCREASED ACTIVITY at and near Marysvale; new alunite discoveries made. Residents of Marysvale approved $16,000 bond issue for water system.

BUCKSKIN MOUNTAIN COPPER (Marysvale)—Shipping ore accumulated on the dump. Will be hauled to Marysvale.

FLORENCE MINING AND MILLING (Marysvale)—Mill site secured in Sevier River bottom, a mile from Marysvale.

DEER TRAIL (Marysvale)—Ore of good grade opened in tunnel at 1,800 ft. There is tonnage of milling ore, and mill may be built. Property is near mouth of Cottonwood Cañon, 6 mi. from Marysvale, and near the potash plant of the Mineral Products Co.

MINERAL PRODUCTS (Marysvale)—Treating 100 tons of alunite daily. Some changes and improvements in mill being made to reduce dust losses from kiln and drying room. The large alunite vein has been followed 1,000 ft. by a tunnel, and is now from 20 to 25 ft. wide. Company planning erection of houses for employees.

Salt Lake County

SHIPMENTS FROM ALTA of four cars or more daily being made, the South Hecla being heaviest shipper. Michigan-Utah, Wasatch Mines, Alta Consolidated, Albion and Sells also shipping.

CONGOR (Bingham)—Thirty to forty tons being shipped daily from 120-ft. level.

MICHIGAN-UTAH (Alta)—About 40 tons daily being shipped by lessees from above the Cleaves tunnel and Grizzly workings. Indebtedness much reduced.

ALBION (Alta)—High-grade ore marketed from upper workings. Both shipping and milling ore opened. Crushing machinery, jigs and concentrating tables will be installed to treat the latter.

SOUTH HECLA (Alta)—Reported strike on 900-ft. level, 2,000 ft. from portal of Quincy tunnel. Ore opened by South Hecla Extension, which is drifting for its own ground. New strike is under lease to the South Hecla Extension.

Summit County

SILVER KING CONSOLIDATED (Park City)—Quarterly dividend $63,750 declared, making total to date $942,372. Shipping 60 tons daily of first-class ore. Work on new mill and other improvements progressing.

JUDGE MINING AND SMELTING (Park City)—Recent tailings from flotation plant carry 0.1 to 0.4% Pb and 1.6 to 1.8% Zn. Flotation concentrates tabled for lead and zinc separation, the tailings from this separation being returned and refloated in separate cell for lead product.

Tooele County

OPHIR AND DRY CANON districts are active. More leasing than in some time, and heavier tonnage being shipped. Working at the Dry Cañon Consolidated, Wandering Jew, Big Lead, Kearsarge, Mono Development and Eureka-Ophir.

BROOKLYN (Stockton)—Lessees shipping silver-gold ore high in iron.

QUEEN OF THE HILLS (Stockton)—Silver-lead-zinc ores being mined by lessees.

HIDDEN TREASURE (Stockton)—High-grade zinc ore being shipped from upper workings.

WASHINGTON

Stevens County

ELECTRIC POINT MINING CO. (Northport)—Hauling high-grade lead ore over new 14-mi. road to Boundary. Shaft 200 ft. deep. Driving crosscut tunnel to tap orebody at 360 ft. below outcrop. Roy A. Young, president.

WISCONSIN

IRON LANDS in northern Wisconsin were studied by Wisconsin Geological Survey which has issued blueprints—in advance of printed reports—covering magnetic lines, roads, streams, etc., for 20 townships in Ashland, Bayfield, Price, Sawyer and Rush counties. Exploratory drilling will be conducted by W. D. Edson, of Duluth, Minn., a Cuyuna Range operator, in Township 41-7, 9 mi. east of Hayward in Sawyer County; this is an entirely new field.

Zinc-Lead District

VINEGAR HILL (Platteville)—Will construct mill on Yewdall property, adjoining Rundell mine at Livingston.

SALLY WATERS (Platteville)—The 100-ton mill completed by R. E. Davis and Douglas Corner at New Diggings.

LINDEN ZINC CO. (Linden)—Overhauling Campbell Separating plant at Cuba City; 2 new Singer-Campbell kilns to be installed; capacity 75 tons green ore daily.

WISCONSIN ZINC CO. (Platteville)—Sinking Little Joe shaft at New Diggings on J. M. Thompson land adjoining Longhorn shaft which penetrated 2½ ft. solid ore at 80 ft., and is being sunk 135 ft.

WYOMING

MIDWEST SULPHUR (Cody)—New plant, about 3 mi. from Cody, being doubled; capacity by July 1 will be 15 tons daily of refined sulphur. Rock runs from 40% upward in sulphur. Output sold for two years. S. H. Corfield, manager.

CANADA

British Columbia

STANDARD SILVER LEAD (Silverton)—Expenditures: April, supplies, $13,765; labor, $24,001; total, $37,766; receipts, $131,309; apparent operating profit, $93,543; net profit, $86,774.

HIGHLAND VALLEY MINING AND DEVELOPMENT CO. (Spokane, Wash.)—Building mill to concentrate 6% copper ore of Chataway and Samson groups in Highland Valley, about 20 mi. southwest of Ashcroft. Mill to be ready in August, comprises Union Iron Works crusher and rolls, Hardinge mill, Anaconda deslimer, Butchart tables, Minerals Separation flotation cells and Oliver filter to dewater concentrates. Frederic Keffer, general manager.

Ontario

WEST DOME (Porcupine)—Cut three veins with diamond drill.

VIPOND (Porcupine)—Cut main orebody on the 400 and 500 levels.

TOUGH OAKES (Kirkland Lake)—New body of rich ore cut on 250-ft. level.

CASEY SENECA (Cobalt)—Closed. Development failed to find any silver.

HOLLINGER (Porcupine)—Contracts let for foundation work on 2,000-ton addition to mill.

NEWRAY (Porcupine—New company formed to take over Rea mine; formerly worked by leasing company.

DOME LAKE (Porcupine)—Mill capacity increased to 80 tons a day, the Koering cyaniding system being used.

McKANE (Kirkland Lake)—Under option to the Beaver; company report states development is highly satisfactory.

BELLELLEN (South Lorrain)—Shaft, down 280 ft., will be continued until contact is reached. Car of ore ready for shipment.

LUCKY CROSS (Swastika)—Under option to the Trethewey. Underground work stopped but surface prospecting will be continued.

COBALT LAKE (Cobalt)—Mill closed. Now belongs to Mining Corporation of Canada and ore is being treated in main plant at the Townsite.

TRETHEWEY (Cobalt)—Mill now working on broken ore left in mine when closed owing to low price of silver. Extensive exploration planned.

ROGNON (Dryden)—Vein has been stripped for nearly half-a-mile showing free gold at intervals. Another shaft started on high-grade ore shoot.

CROWN RESERVE (Cobalt)—Has given up option on McCrea properties at Boston Creek, but will do surface work on two other properties in district.

HURONIAN (Larder Lake)—Will be reopened. Small tonnage of rich ore developed by Hollinger interests, but price was too high to permit them to acquire.

ADANAC (Cobalt)—New hoist installed and drifting commenced on 300-ft. level on 10-in. vein. Raising from 340-ft. level to connect with orebody on the 280.

McKINLEY DARRAGH (Cobalt)—Flotation-plant heads run 7 to 8 oz. and tails 1½ to 2 oz.; capacity 150 tons a day. Expect to improve extraction.

PLENAURUM (Porcupine)—Being taken over by Nipissing company of Cobalt. Immediate expenditure of $50,000 required. Mine has two good oreshoots but tonnage is small.

PETERSON LAKE (Cobalt)—At acrimonious meeting in Toronto, June 17, old board of directors reelected. Cash assets, $202,427. Income practically all from royalties from Seneca Superior.

BEAVER (Cobalt)—Main shaft down 1,630 ft. Lower contact of diabase and Keewatin encountered at 1,570 ft. Station being cut at 1,600-ft. level for lateral development. High-grade ore, about 4 in. wide, 530-ft. level, proved for 20 ft.

NIPISSING (Cobalt)—In May mined ore, estimated net value of $291,898, and shipped bullion, from Nipissing and customs ore, estimated value of $420,822. High-grade mill treated 18 tons and shipped 558,148 fine ounces; low-grade mill treated 7,032 tons.

McINTYRE (Porcupine)—Ore reserves estimated at 202,000 tons, averaging $11, but do not include ore on 1,000-ft. level, It is officially stated that new vein on 1,000-ft. level shows 16 ft. of ore. Independent examination of McIntyre, McIntyre Extension and Jupiter will be made to arrive at basis for amalgamation.

MEXICO

Nuevo Leon

MONTEREY STEEL AND IRON (Monterey)—Notwithstanding unsettled conditions the Monterey Steel and Iron works has been in continuous operation for the last few months. Iron ore comes from northern Nuevo Leon and the Iron Mountain in Durango. Steel billets being sent to France and Italy.

The Market Report

Metal Markets

NEW YORK—June 21

The last was again a week of dullness and reactionary tendencies, but lead was an exception, becoming a little stronger.

Copper, Tin, Lead and Zinc

Copper—This market was again very dull, but more business than in the previous week was reported, there being several sales of million-pound lots. Certain of these were for foreign account. Toward the close the market became weaker, July-August copper being reported offered at 26½c., regular terms.

The copper market is in an interesting condition. There has been a rather long period of dullness and some sellers, who are well sold up, but nevertheless not so well as they would like to be, have been negotiating with prospective buyers to find a basis for business. There is also apparently truth in the reports of more foreign business pending. Whatever it be, matters have not yet gone beyond negotiations respecting price, as to which agreement has not yet been reached.

The "Journal of Commerce" of June 9 made the following interesting report: "An unusual case affecting freight charges on a shipment of copper from Tacoma has just been settled. It appears that a Canadian buyer placed an order with a New York house for some copper, the price being based on New York delivery. The buyer later on arranged with the seller to furnish delivery at Buffalo. The seller ordered the copper shipped from Tacoma and it was unloaded at Buffalo without ever coming to New York. The seller charged the buyer the cost of the freight on the copper from New York to Buffalo, against which the buyer protests, claiming that as the copper had never been in New York such a charge should not be made. The arbitrator ruled that the charge made by the seller was proper in that the buyer had made a purchase of copper at New York and later instructed delivery at Buffalo and that although the copper had come direct to Buffalo from Tacoma that the seller had fully complied with the terms of the sale and was entitled to the freight charge."

Exports from Baltimore for the week included 9,520,878 lb. copper to Great Britain; 20,030 lb. to Rotterdam, Holland.

Copper Sheets are unchanged at 37.5c. for hot rolled and 38.5c. for cold rolled. Copper wire is 32@32½c. per lb. for large lots at mill.

Visible Stocks of Copper in Europe on June 15: Great Britain, 2,459; France, 4,000; afloat from Chile, 1,500; afloat from Australia, 4,300; total, 12,259 long tons—or 27,460,160 lb.—which is a decrease of 1,403 tons from the May 31 report.

Tin—This market declined from day to day, following the decline in London. There was an absence of buying here, a bearish feeling and a lack of confidence generally.

Tin exports from the Federated Malay States in May were 3,722 long tons. For the five months ended May 31 they were 19,270 tons in 1915, and 18,224 in 1916; decrease, 1,046 tons.

Lead—There was improved inquiry right through the week, and a considerable volume of business done, as reported by several producers. One or two producers, however, continued to report slackness of demand and sales at relatively low prices. Toward the close, quotations were made on some large lots of lead for export, and with this business coming in sight the market became appreciably firmer. The prospect of trouble with Mexico was of but little effect, scarcely any pig lead having been coming out of that country lately. However, there have been some importations of lead in ore which may be cut off.

The statistical position of lead without any doubt continues very strong, the stocks—in all forms, including ore, byproducts and bullion—in the hands of the principal producers being very small. Buyers, on the other hand, have been purchasing only according to their requirements for current consumption.

Spelter—This metal was again weak on rather small business. The principal producers are believed to be accumulating spelter, but there was absolutely no pressure from any important quarter to sell prompt and near-by metal. The market declined further, however, on the offerings of smaller producers, and the absence of any general buying demand. But few sales for domestic consumption were reported. The largest single sale during the week that we heard of was for export. Right through the week prompt spelter was offered at 12c., declining to 11¾ at the close, when July was quoted at 11½c. and August at 11c. In the early part of the week spelter for last-quarter delivery was quoted at 10¾c. Toward the close it was 9¾c., bid, 10¼c., asked. High-grade spelter was quoted at 25c., and intermediate at 18c. Brass special containing 0.6% lead was sold at 13c., for prompt delivery on June 17, and at 12¾c. on the 20th.

DAILY PRICES OF METALS IN NEW YORK

June	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc
			Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	St. Louis, Cts. per Lb.
15	4.7569	62⅞	26¾ @27	42½	6.75 @7.00	6.50 @6.75	11.25 @12.00
16	4.7575	63⅛	26¾ @27	42	6.75 @7.00	6.50 @6.75	11.25 @12.00
17	4.7581	63⅜	26¾ @27	41½	6.75 @7.00	6.50 @6.75	11.25 @12.00
19	4.7575	64¼	26½ @26¾	41	6.75 @7.00	6.50 @6.75	11.00 @11.75
20	4.7575	64⅛	26½ @26¾	40⅞	6.75 @7.00	6.50 @6.75	11.00 @11.75
21	4.7569	64¼	26¾ @26½	40	6.90 @7.00	6.70 @6.80	11.00 @11.75

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" (r.t.) is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only the St. Louis price is herein quoted, St. Louis being the basing market. We quote the New York price at 17c. per 100 lb. above the St. Louis price.

Silver quotations are as reported by Handy & Harman and are in cents per troy ounce of silver bars 999 fine.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

June	Silver	Copper				Tin		Lead		Zinc	
		Standard		Electrolytic							
		Spot	3 Mos.	£ per Ton	Cts. per Lb.	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
15	30 7/16	118	116	140	29.81	181¼	181⅜	31½	6.71	68	14.48
16	30 5/16	113	110	140	29.81	178	178½	31⅞	6.79	68	14.48
17	30½	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
19	30 11/16	110	106	139	29.60	178	178¼	31⅞	6.79	68	14.48
20	30⅝	106	103	138	29.38	177	177¼	31⅞	6.79	68	14.48
21	30 11/16	98	96	137	29.18	173¼	173½	31	6.60	67	14.27

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for electrolytic, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21⅜c.

Zinc Sheets are again easier. The base price was reduced on June 21 to $19 per 100 lb., f.o.b. Peru, Ill., less 8% discount.

Other Metals

NEW YORK—June 21

Aluminum—The market has been active and a good demand is reported. Prices have again hardened and quotations today are reported at 63@65c. per lb. for No. 1 ingots, New York.

Antimony—There is no change in conditions, the market continuing dull and weak with gradually receding prices. Spot has sold at 18@19c. per lb. Shipments from China within one month are quoted at 17c. per lb., c.i.f., New York, duty unpaid.

Nickel—The market continues steady with about the same amount of domestic business as usual and with some demand for export. Quotations are 45@50c. per lb. for ordinary forms, according to size and terms of order. Electrolytic nickel brings 5c. per lb. premium.

Quicksilver continued to fall in the early part of the week, prices receding to $65 per flask of 75 lb., New York, with one sale reported as low as $61 per flask. On June 19 there was a sharp upturn in the market, and prices advanced to $68 or $70. The quotation today is $72@74 per flask, with better demand and an upward tendency. Buyers seem to have exhausted their stocks and have come into the market. The probable stoppage of exports from Mexico has also helped the price.

San Francisco reports by telegraph more business and a firmer market at $70@72.50 per flask. London prices are unchanged at £16 10s. per flask.

Minor Metals—Current quotations for **Bismuth** are $3.15@3.25 per lb., New York. The London price is 11s. per lb.—**Cadmium** is quoted at $1.25@1.50 per lb.—**Cobalt** is $1.25 per lb.—**Magnesium** is quoted at $5.50 per lb. for 99% pure.—**Selenium** is from $3 up to $5 per lb., according to quantities.

EXPORTS AND IMPORTS

Imports of Zinc in all forms in April and the four months ended Apr. 30 are reported by the Department of Commerce as follows, in pounds:

	April	Four Months
Zinc in ores	31,416,141	127,889,337
Metallic zinc	125,966	561,062
Zinc dust	89,317	878,550

Of the zinc dust imported for the four months 556,950 lb. came from Japan. The total quantity of ore imported for the four months was 147,803 tons

Exports of Zinc for April and the four months ended Apr. 30 were, in pounds:

	April	Four Months
Pigs, bars, etc., from dom. ores	9,375,105	47,080,918
Pigs, bars, etc., from foreign ores	2,424,005	18,473,548
Plates and sheets	8,275,254	25,564,369
Zinc, blocks, etc., reëxported	.....	336,000
Total metallic zinc	20,174,364	91,454,835
Zinc dross	.....	3,209,445
Zinc dust, reëxported	1,000	97,419

There was exported in April 30 tons of zinc ore, value not reported.

Exports of Minerals and Metals from Spain, quarter ended Mar. 31, as reported by "Revista Minera," in metric tons:

	Metals		Ores, etc.	
	1915	1916	1915	1916
Iron	37,515	21,568	962,457	1,117,133
Copper	3,933	4,316	11,489	14,717
Copper precipitate	2,044	3,046	.....	.....
Lead	32,965	42,927	183	756
Zinc	623	1,122	474	28,532
Quicksilver	372	417	.....	.....
Manganese	.....	.....	1,970	256
Pyrites	.....	.....	333,372	837,012
Salt	.....	.....	89,367	86,917

Imports of coal for the quarter this year were 452,939 tons, an increase of 86,634 tons, as compared with 1915. Imports of coke were 38,847 tons, an increase of 1,596 tons.

Gold, Silver and Platinum

NEW YORK—June 21

Gold—Receipts from Canada at New York still continue. The latest reported is $3,500,000 on June 20, making a total of $66,000,000 during the past month.

Platinum—The market continues very quiet, with small transactions only. There is no material change in prices, which are reported by dealers at $77@79 per oz. for refined platinum. Hard metal is $4@6 per oz. higher, according to quality.

Imports of platinum in March were 5,429 oz., against 324 oz. in March of last year.

Our Russian correspondent writes that during the last fortnight, since the platinum industry and market were declared free from official control, there has been a considerable revival in activity. In Petrograd, some quantities have been sold at 68,000 rubles per pood and negotiations are pending for a further sale.

Iridium is scarce and prices are high. Up to $85 per oz. is named but most transactions are a matter of special agreement.

Silver—The market is quiet, and is held in hand by the buyers rather than by the seller, owing to an understanding by which competitive buying in London is not so keen as heretofore. Supplies are about equal to demand.

Mexican dollars have been quoted in New York, June 15, at 48½@53½c.; June 16 at 48½@53½c.; June 17 at 48½@53¾c.; June 18 at 49⅛@54⅛c.; June 20 at 49¾@55c. The range is rather unusual.

Zinc and Lead Ore Markets

JOPLIN, MO.—June 17

Blende, high price, $92.45; per ton 60% zinc, premium ore, $90; medium, $85@75; to as low as $65; calamine, per ton 40% zinc, $60@45; average selling price, all grades of zinc, $77.20 per ton. Lead, high price, $83.85; base, $82@80 per ton 80% metal content; average selling price, $80.38 per ton.

SHIPMENTS WEEK ENDED JUNE 17

	Blende	Calamine	Lead	Values
Totals this week	13,464,280	1,024,340	1,555,370	$641,780
Totals this year	334,295,000	27,569,900	56,549,630	$21,187,140

Blende value, the week, $552,110; 24 weeks, $17,623,340.

Calamine value, the week, $27,170; 24 weeks, $999,540.

Lead value, the week, $62,500; 24 weeks, $2,564,260.

One group of large producing mines is idle on account of litigation, and scattering ones are still engaged in midsummer repairs and extensions, thus the output continues to be partially restricted. The output is still heavy and the reserve stock has reached heretofore unrecorded proportions, approximating 19,000 tons. No mines are now idle on account of the strike. Those desiring to resume operations have employed nonunion hoistermen.

PLATTEVILLE, WIS.—June 17

The base price paid this week for 60% zinc ore was $77@73 per ton for top grades down to $70 for medium grades. The base price paid for 80% lead ore was $80 per ton.

SHIPMENTS WEEK ENDED JUNE 17

	Zinc Ore, Lb.	Lead Ore, Lb.	Sulphur Ore, Lb.
Week	4,840,000	110,000	766,900
Year	108,524,000	3,921,930	27,536,600

Shipped during week to separating plants, 6,934,000 lb. zinc ore.

MONTANA ZINC ORE

The Butte & Superior in May produced 15,140 tons of blende concentrates, averaging 53.81% zinc.

OTHER ORES

Manganese Ore continues strong though rather unsettled. Prices are not easy to quote, as most ore imported is on contract. About 75@85c. per unit for Brazilian ores is the range. There are no Indian ores on the market just at present.

The U. S. Manganese Corporation has been incorporated at Albany, N. Y., by W. R. Hopkins, M. P. Dalton, H. H. Meyers and others, to mine and smelt manganese ore. The mine is located at Elkton, Va., and comprises 1,000 acres, which the new company owns or controls. For the past six months explorations on this property have been going on and quantities of high-grade ores are claimed to be assured. Besides selling ore in the market the company has leased a blast furnace for producing ferro-manganese.

Tungsten Ore seems to have settled down to a range of $30@40 per unit, on rather small transactions. Negotiations are said to be pending for some quantities for export to France and Russia, but no large transactions have been closed as yet.

Antimony Ore is no longer offered from South America because at present prices for the metal and high ocean freights it does not pay to ship.

Iron Trade Review

NEW YORK—June 21

The main changes during the week have come from the export demand, which has been strong. Besides the orders for shells and other war material, some large contracts have been

placed for rails and cars for Russia; also for plates for shipbuilding for Japan. The Japanese orders have been pending for some time.

No price changes of any amount are reported. It is to be remembered that a number of low-priced contracts will expire July 1, and that this will involve some further readjustments of price. The present high levels seem to have discouraged some purchasing, notably in structural steel.

The pig-iron market continues rather notably dull, and some weakness in prices is reported, especially in Southern foundry iron.

Exports of Iron and Steel from the United States in April for which tonnages are given were 384,920 gross tons, an increase of 161,678 tons over April, 1915. The value of machinery exports for the month was $17,526,899, being $7,127,183 more than last year. The value of all shipments of iron and steel and their products was $58,722,411, showing an increase of $38,082,842. The exports for the four months ended Apr. 30 were as follows, tonnage of those exports which are reported by weight being given in gross tons:

	1915	1916	Changes
Tonnage exports	680,853	1,569,011	I. 888,158
Machinery exports, value	$36,066,499	$62,040,653	I. 125,984,154
Total exports, value	118,146,676	287,156,032	I. 169,009,356

The total increase this year was 143.1%. Imports in April, so far as reported by weight, were 16,569 tons in 1915, and 20,028 in 1916; increase, 3,459 tons.

PITTSBURGH—June 20

The steel market has grown still quieter, except in the export direction. There is practically no buying of any consequence by domestic consumers or jobbers and no expectations are entertained that there will be any greater activity this side of September. Steel producers appear to be well content with the situation and are evidently well filled with orders on which buyers will take deliveries as rapidly as they can be made.

The quietness emphasizes the inherent strength in the situation, in that there is no disposition to cut prices, regular prices of all steel products being maintained with the utmost firmness. Premiums for early deliveries have continued to decrease, except as to plates, and are now relatively unimportant.

Export demand is heavy, as it has been for several weeks, and the neutral countries are more prominent as buyers than formerly. The Allies are still buying freely. Russia has placed with the Steel Corporation about one-half the 350,000 tons of rails recently inquired for, and is having difficulty in arranging with independent rail mills for the deliveries desired.

Tinplate is showing remarkable strength, the domestic market having advanced squarely to a minimum of $6 a base box, as against the season price of $3.60 named last November Even higher prices are obtained for export. All the mills are crowding for tonnage and the output in the first half of the year is probably between 10 and 20% greater than in any preceding half year.

Pig Iron—Bessemer iron is a shade easier, though still quotable at $21, Valley. Chicago has suddenly appeared as a seller of bessemer for export, and has cut the Valley equivalent price. The demand is heavy and it is thought there will be enough for both districts. The domestic market is extremely quiet in all grades and foundry is off 25c. owing to free offerings of resale iron due to light production by foundries on account of the molders' strike. We quote: Bessemer, $21; basic, foundry and malleable, $18.25@18.50; forge, $18, f.o.b. Valley furnaces, 95c. higher delivered Pittsburgh.

Steel—The steel market is found to be very strong when a consumer desires to buy a specific tonnage made to his requirements as to analysis and size, but rather weak when an odd lot of predetermined character is to be disposed of. The filling of war-steel orders has occasioned the production of altogether too much discard and rejected steel for the market to absorb. Billets and sheet bars are quotable at $40@42 for bessemer and $40@45 for openhearth, the higher figures being for regular deliveries to the buyers' specifications. Rods are $55@60 and forging billets $65@70 per ton.

FERROALLOYS

Spiegeleisen is in better supply and is quoted $60@65 per ton at furnace for 20%, and about $70@75 for prompt delivery.

Ferrosilicon is unchanged at $83@85 at furnace for 50%. Bessemer ferrosilicon is from $33 per ton for 10% up to $43 for 16%, at furnace. Premiums of $5@7.50 per ton are still charged on early deliveries.

Ferromanganese—The market continues extremely quiet. There is scarcely any demand for prompt and thus while supplies are light the market is not strong, being about $225@250 for prompt or July. The contract price remains at $175, only next year's deliveries being offered.

FOREIGN IRON TRADE

German production of rolled iron and steel in 1915, as reported by the German Iron and Steel Union, in metric tons: Billets, blooms, etc., 1,641,951; rails and rail joints, 1,424,538; beams and girders, 765,653; bars, 3,328,685; hoops, 265,139; wire, 750,934; plates, 966,898; sheets, 628,695; tinplates, 92,751; tubes, 460,765; rolling billets, 192,080; forging billets, 236,680; miscellaneous, 487,581; total, 11,243,360 tons, against 13,165,589 tons in 1914, and 16,698,950 tons in 1913. The output was equivalent to about 68% of that of a normal year.

Pig-Iron Production in Germany in April is reported at 1,073,706 metric tons, being 42,488 tons less than in March. For the four months ended Apr. 30, the total make was 6,149,690 tons in 1914, before the war began; 3,554,873 tons in 1915, and 4,302,951 tons in 1916. This year's production is 748,078 tons more than in 1915; it is 70% of that in 1914, a normal year.

IRON ORE

Shipments of Lake Superior ore are very heavy and June will show a high total. Besides the usual tonnage already under charter, there is a demand for more boats, and $1 per ton is said to have been offered for wild tonnage from Duluth or Two Harbors.

The strike of miners on the Mesabi range may interfere seriously with shipments in July, if it continues.

COKE

Coke production for the week in the Connellsville region is reported by the "Courier" at 405,804 net tons; shipments, 408,383 tons. Production decreased owing to sales of raw coal to the Pittsburgh district, a result of the strike there. Shipments of Greensburg and Upper Connellsville districts, 41,187 tons.

Connellsville—The market on contract furnace coke has softened a trifle. Operators making the best grades, who were recently firm at $2.75, are now willing to take $2.65, while other grades could probably be had at as low as $2.50. The Connellsville operators have lost several contracts on which they were negotiating, Pocahontas operators having sold some coke into the Chicago district, with a freight advantage of 25c., while the Lehigh Coke Co. at South Bethlehem has sold some Eastern consumers. With the recent addition this plant now has a surplus of coke for the open market, beyond the requirements of the Bethlehem furnaces. Spot furnace coke is stagnant. There is a fair demand for foundry coke, both spot and contract. We quote: Spot furnace, $2.40@2.50; contract, $2.50@2.65; spot foundry, $3.25@3.50; contract, $3.50, per net ton at ovens.

Austrian Coal Production, quarter ended Nov. 31, in metric tons:

	1914	1915	Changes
Coal	4,021,354	4,427,283	I. 405,929
Brown coal	5,724,905	5,978,405	I. 253,500
Coke made	441,335	614,628	I. 173,293
Briquettes made	123,788	113,226	D. 10,562

Of the briquettes reported this year 61,552 tons were made of brown coal, or lignite.

Chemicals

NEW YORK—June 21

The general market is again quiet and a tendency to moderate activity is quite manifest.

Arsenic—Demand is moderate only and there has been some competition for orders. Prices are rather weak, but show little change, at $6.25 per 100 lb. for spot and $6 for futures.

Copper Sulphate—A moderate business is forward but transactions have not been heavy. Quotations remain fairly steady at $14@15 per 100 lb. for large lots.

Nitrate of Soda—Supplies continue large but demand is good and no weakness is apparent in the market. Current quotations are strong at $3.10 per 100 lb. for spot; $3.15@3.20 for futures. May shipments from Chile are reported at 94,300 tons, of which 88,000 tons were to the United States.

Sulphur—This article is in good demand and a fair volume of business is reported. Quotations are steady at $30 per ton, New York.

Sulphuric Acid—The market is a little easier and some shading is reported. The current quotation is $22@25 per ton for 60-deg. acid at works, buyers to furnish tank cars. For 66-deg. acid $40@45 per ton is asked.

Assessments

Company	Delinq.	Sale	Amt.
Advance, Mont.	June 15	July 15	$0.005
Algomah, Mich.	May 18	.....	1.00
Alpha, Nev.	June 7	June 28	0.03
Arbroath, Wash.	June 1	July 1	0.002
Best & Belcher, Nev.	June 9	June 28	0.05
Blue Bell, Ida.	July 8	Aug. 5	0.002
Bullion, Ida.	July 10	July 31	0.01
Cedar Creek, Ida.	July 5	Aug. 5	0.01
Central Eureka, Calif.	June 16	July 14	0.05
Challenge, Nev.	June 12	July 7	0.05
Columbus Ext., Utah	July 13	Aug. 8	0.02
Confidence, Nev.	June 23	July 14	0.10
East Hercules Ext., Ida.	May 1	July 3	0.0015
Emerald, Utah	June 15	July 8	0.0033
Fortuna, Utah	June 15	July 8	0.005
Friend, Ida.	June 30	July 20	0.002
Giant, Ida.	June 16	July 17	0.003
Goldstrike Bon., Utah	June 15	July 15	0.01
Ould & Curry	July 14	Aug. 3	0.03
Idaho & Los Angeles, Ida.	June 2	July 1	0.005
Imperial, Ida.	June 12	July 12	0.005
Independence, Ida.	July 8	July 29	0.001
Laclede, Ida.	July 3	July 25	0.003
Leonora, Utah.	June 20	July 11	0.005
Liberty, Utah.	June 15	July 3	0.005
National, Ida.	June 2	July 3	0.02
North Franklin, Ida.	June 19	July 8	0.005
North Lake, Mich.	June 14	.....	1.00
Old Veteran, Ida.	July 8	Aug. 5	0.002
Ophir, Nev.	June 13	July 6	0.05
Phedora, Ida.	May 9	July 1	0.005
Rio Grande, Nev.	June 22	July 22	0.002
Rob Roy, Ida.	June 10	July 10	0.002
Rockford, Ida.	June 30	July 21	0.002
Roosevelt, Utah.	June 1	July 1	0.02
Sierra Nevado, Nev.	July 11	Aug. 3	0.10
Silver Pick, Nev.	July 5	Aug. 14	0.01
Silver Star, Ida.	June 14	July 1	0.002
Sonora, Ida.	June 5	June 30	0.004
Sunset, Ida.	June 3	June 24	0.002
Swansea, Utah.	July 10	Aug. 1	0.0025
Uvada, Nev.	June 24	July 27	0.02
Wallace, Ida.	June 29	July 29	0.0025

Stock Quotations

SAN FRANCISCO June 20	
Name of Comp.	Bid.
Alta	.05
Andes	.14
Best & Belcher	.06
Bullion	.03
Caledonia	.43
Challenge Con.	.05
Confidence	.12
Cons. Imperial	.01
Con. Virginia	.14
Gould & Curry	.02
Hale & Norcross	.10
Jacket-Cr. Pt.	.06
Mexican	.19
Occidental	.70
Ophir	.25
Overman	.07
Savage	.06
Seg Belcher	.02
Sierra Nevada	.27
Union Con.	.90
Utah Con.	.01
Belmont	4.25
Jim Butler	.90
MacNamara	.07
Midway	.24
Mont.-Tonopah	.25
North Star	.17
Rescue Eula	.44
West End Con.	.96
Atlanta	.10
Blue Bell	.01
Booth	.15
C.O.D. Con.	.03
Comb. Frac.	.07
D'field B.B.	.03
D'field Daisy	.03
Jumbo Extension	.82
Pitts.-Silver Peak	.09
Round Mountain	.62
Sandstorm Kendall	.05
Silver Pick	.09
Central Eureka	.08
Argo	.10
Big Jim	1.00
Lazy Boy	.15
Oatman Cres.	‡.42
Oatman No. Star	.18
Tom Reed	1.50
United Eastern	3.93½
United Western	.15

LONDON June 8	
Alaska Tre'dwell	£3 7s 6d
Burma Corp.	2 13 1½
Cam & Motor	0 14 0
Camp Bird	0 9 9
El Oro	0 10 0
Esperanza	0 11 3
Mexico Mines	4 2 6
Nechi, pfd.	0 3 6
Oroville	0 16 0
Santa Gert'dis.	0 15 0
Tomboy	1 3 6

SALT LAKE June 20	
Name of Comp.	Bid.
Alta Con.	.56
Black Jack	.10
Colorado Mining	.17
Crown Point	.04½
Daly-Judge	7.90
Emma Cop.	.46
Gold Chain	.25½
Grand Central	.70
Iron Blossom	1.75
Lower Mammoth	.03½
May Day	.13½
Opohongo	.01½
Prince Con.	1.30
Seven Troughs	.02½
Silver King Coal'n	2.90
Silver King Con.	3.17½
Sioux Con.	.12½
Uncle Sam	.05
Yankee	.20

COLO. SPRINGS June 20	
Acacia	.03½
Cripple Cr'k Con.	‡.00½
Doctor Jack Pot.	.09½
Elkton Con.	.17
El Paso	.79
Findlay	.03½
Gold Sovereign	.03½
Golden Cycle	2.11
Granite	.66½
Isabella	.16½
Jack Pot	.05
Jerry Johnson	.04
Mary McKinney	.38
Portland	1.65
Vindicator	2.25

TORONTO June 20	
Bailey	.07
Chambers Ferland	.22
Coniagas	5.00
La Rose	.56½
Peterson Lake	.26
Right of Way	‡.05
Seneca Superior	.28
T. & Hudson Bay	‡33.00
Temiskaming	.64
Trethewey	.22
Wettlaufer-Lor.	.07
Dome Exten.	.38
Dome Lake	.33
Foley O'Brien	.50
Hollinger	29.00
Imperial	‡.03
Jupiter	.34
McIntyre	1.56½
Porcu. Crown	.87½
Preston E. D.	‡.03
Vipond	.57
West Dome	.39

N. Y. EXCH. June 20	
Name of Comp.	Clg.
Alaska Gold M.	20
Alas'a Juneau	8½
Am.Sm.&Ref.,com.	94½
Am. Sm. & Ref., pf.	111½
Am. Sm. Sec., pf. A	93½
Am. Sm. Sec., pf. B.	83½
Am. Zinc	49
Am. Zinc, pf.	69
Anaconda	83
Batopilas Min.	1½
Bethlehem Steel	443
Bethlehem Steel, pf.	132
Butte & Superior	72½
Chile Cop.	21
Chino	50½
Colo. Fuel & Iron	41½
Crucible Steel	80½
Dome Mines	26½
Federal M. & S.	17
Federal M. & S., pf.	36
Great Nor., ore ctf.	36½
Greene Cananea	44
Homestake	130
Inspiration Con.	48½
International Nickel	46½
Kennecott	50
Lackawanna Steel	69½
Miami Copper	35½
Nat'l Lead, com.	66
National Lead, pf.	113
Nev. Consol.	17
Ontario Min.	6½
Quicksilver	3½
Quicksilver, pf.	4½
Ray Con.	21½
Republic I&S, com.	46
Republic I&S, pf.	107½
Sloss-Sheffield	51
Sloss-Sheffield, pf.	94
Tennessee Copper	45½
Utah Copper	78
U. S. Steel, com.	84½
U. S. Steel, pf.	117½
Va. Iron C. & C.	48

N. Y. CURB June 20	
Adanac	.67
Beaver Con.	.43
Buffalo Mines	1
Butte & N. Y.	2
Butte C. & Z.	6
Can. Cop. Corpn.	1 1/16
Cashboy	.07½
Cerro de Pasco	36
Con. Ariz. Sm.	1½
Con. Coppermines	2 7/16
Con. Nev.-Utah	⅜
First Nat. Cop.	4
Florence	.40
Goldfield Con.	.87
Goldfield Merger	.09
Granite	.35
Hecla Min.	5½
Howe Sound	4⅜
Jerome Verde	1 3/16
Joplin Ore & Spel.	4½
Kenefick Zinc	‡13½
Kerr Lake	4½
Magma	15½
Majestic	7/16
McKinley-Dar-Sa.	.52
Mines of Am.	2½
Mother Lode	.28½
Nevada Hills	.21
N. Y. & Hond.	16½
Nipissing Mines	7
Oro	.05
Ray Hercules	3⅜
Rochester Mines	.65
St. Joseph Lead	16
Standard S. L.	1½
Stewart	.25
Success	.81
Tonopah	6½
Tonopah Ex.	5½
Tribullion	7/16
White Knob, pf.	1½
Yukon Gold	2

BOSTON EXCH June 20	
Name of Comp.	Bid
Adventure	2½
Ahmeek	97
Algomah	1½
Allouez	64½
Ariz. Com., ctfs.	8½
Bonanza	.31
Butte-Balaklava	2½
Calumet & Ariz.	60⅜
Calumet & Hecla	520
Centennial	16½
Copper Range	61
Daly West	2⅜
East Butte	12½
Franklin	7½
Granby	89½
Hancock	12½
Hedley	‡20
Helvetia	.25
Indiana	3
Island Cr'k, com.	48½
Island Cr'k, pfd.	90½
Isle Royale	27
Keweenaw	4½
Lake	13½
La Salle	3½
Mason Valley	2½
Mass	11⅜
Mayflower	2½
Michigan	3
Mohawk	97½
New Arcadian	6½
New Idria	‡13
North Butte	22
North Lake	1½
Ojibway	1½
Old Colony	2
Old Dominion	66½
Osceola	92
Quincy	89
St. Mary's M. L.	77
Santa Fe	2
Shannon	8½
Shattuck-Ariz.	31
So. Lake	6½
So. Utah	.25
Superior	16½
Superior & Bost.	4½
Tamarack	47
Trinity	5½
Tuolumne	.47
U. S. Smelting	71½
U. S. Smelt'g, pf.	50½
Utah Apex	4½
Utah Con.	13½
Utah Metal	8½
Victoria	3
Winona	5½
Wolverine	54
Wyandot	2

BOSTON CURB June 20	
Bingham Mines	12½
Boston Ely	.61
Boston & Mont.	2½
Butte & Lon'n Dev.	.76
Calaveras	4½
Calumet-Corbin	.04
Chief Con.	1⅜
Cortez	.30
Crown Reserve	.50
Davis-Daly	1½
Eagle & Blue Bell	1½
Houghton Copper	1½
Iron Cap Cop., pf.	6½
Mexican Metals	.32
Mojave Tungsten	6½
Nat. Zinc & Lead	1½
Nevada-Douglas	1
New Baltic	2
New Cornelia	13½
Ohio Copper	.14
Oneco	1
Raven Copper	‡.18
Rex Cons.	.15
Rilla	.85
United Verde Ext.	29½

‡Last Quotations.

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1914	1915	1916	1914	1915	1916
January	56.572	48.855	56.775	26.553	22.731	26.960
February	57.506	48.477	56.755	26.573	22.753	26.975
March	58.067	50.241	57.935	26.788	23.708	27.597
April	58.519	50.250	64.415	26.958	23.709	30.662
May	58.175	49.915	74.269	26.704	23.570	35.477
June	56.471	49.034	.....	25.948	23.267	.....
July	54.678	47.519	.....	25.219	22.597	.....
August	54.344	47.163	.....	25.979	22.780	.....
September	53.290	48.680	.....	24.260	23.591	.....
October	50.654	49.385	.....	23.199	23.925	.....
November	49.082	51.714	.....	22.703	25.094	.....
December	49.375	54.971	.....	22.900	26.373	.....
Year	54.811	49.684	.....	25.314	23.675	.....

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York Electrolytic		London Standard		London Electrolytic	
	1915	1916	1915	1916	1915	1916
Jan.	13.641	24.008	60.756	88.083	65.719	116.167
Feb.	14.394	26.440	63.494	102.667	*	133.167
Mar.	14.787	26.310	66.152	107.714	*	136.000
April	16.811	27.895	75.096	124.319	*	137.389
May	18.506	28.625	77.600	135.457	*	152.522
June	19.477	.....	82.574	.....	95.333	.....
July	18.796	.....	76.011	.....	91.409	.....
Aug.	16.941	.....	68.673	.....	82.333	.....
Sept.	17.502	.....	68.915	.....	85.250	.....
Oct.	17.686	.....	72.601	.....	88.000	.....
Nov.	18.627	.....	77.744	.....	93.273	.....
Dec.	20.133	.....	80.773	.....	100.43	.....
Year	17.275	.....	72.532	.....	.....	.....

TIN

Month	New York		London	
	1915	1916	1915	1916
January	34.260	41.825	156.550	175.548
February	37.415	42.717	176.925	181.107
March	48.426	50.741	180.141	193.609
April	47.884	51.230	166.225	199.736
May	38.790	49.125	162.675	196.511
June	40.288	.....	167.636	.....
July	37.423	.....	167.080	.....
August	34.389	.....	151.440	.....
September	33.125	.....	152.625	.....
October	33.080	.....	151.554	.....
November	39.224	.....	167.670	.....
December	38.779	.....	167.000	.....
Av. year	38.590	.....	163.960	.....

LEAD

Month	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
January	3.729	5.921	3.548	5.826	18.606	31.167
February	3.827	6.246	3.718	6.164	19.122	31.988
March	4.053	7.136	3.997	7.375	21.883	34.440
April	4.221	7.630	4.142	7.655	21.094	34.368
May	4.274	7.463	4.182	7.332	20.347	32.967
June	5.932	.....	5.836	.....	25.170	.....
July	5.659	.....	5.531	.....	24.611	.....
August	4.656	.....	4.520	.....	21.946	.....
September	4.610	.....	4.490	.....	23.151	.....
October	4.600	.....	4.499	.....	23.994	.....
November	5.155	.....	5.078	.....	26.278	.....
December	5.355	.....	5.266	.....	28.807	.....
Year	4.673	.....	4.567	.....	22.917	.....

SPELTER

Month	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
Jan.	6.386	16.915	6.211	16.745	30.844	89.810
Feb.	8.436	18.420	8.255	18.260	39.819	97.762
Mar.	8.541	16.846	8.360	16.676	44.141	95.048
April	10.012	16.695	9 837	16.525	49.888	99.056
May	14.781	14.276	14.610	14.106	68.100	94.217
June	21.208	.....	21.038	.....	100.614	.....
July	19.026	.....	18.856	.....	97.250	.....
Aug.	12.781	.....	12.611	.....	67.786	.....
Sept.	13.440	.....	13.270	.....	67.841	.....
Oct.	12.800	.....	12.596	.....	66.536	.....
Nov.	15.962	.....	15.792	.....	88.409	.....
Dec.	15.391	.....	15.221	.....	89.400	.....
Year	13.230	.....	13.054	.....	67.553	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton. * Not reported.

PIG IRON IN PITTSBURGH

Month	Bessemer‡		Basic‡		No. 2 Foundry	
	1915	1916	1915	1916	1915	1916
January	$14.59	$21.60	$13.45	$18.78	$13.90	$19.70
February	14.55	21.16	13.45	18.93	13.90	19.51
March	14.55	21.81	13.45	19.20	13.95	19.45
April	14.55	21.65	13.45	18.95	13.95	19.45
May	14.61	21.78	13.60	19.11	13.83	19.58
June	14.70	.....	13.67	.....	13.77	.....
July	14.94	.....	13.91	.....	13.68	.....
August	16.01	.....	15.31	.....	14.75	.....
September	16.86	.....	15.95	.....	15.70	.....
October	16.95	.....	15.96	.....	15.80	.....
November	17 57	.....	16.47	.....	17.20	.....
December	19.97	.....	18.44	.....	18.95	.....
Year	$15.82	.....	$14.76	.....	$14.95	.....

‡As reported by W. P. Snyder & Co.

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WITH PRINCIPAL ARTICLES SUMMARIZED

*ILLUSTRATED

*DRILL AND TOOL SHARPENING AT THE COPPER QUEEN MINE 1099

By "G. S."

Central shop for the sharpening of drill and tool steel designed as a result of extended time study and efficiency work. Central shops supply drills for four different shafts situated 2,600 to 3,800 ft. apart. Shop handles and sharpens over 1,200 pieces of steel and tools per day. ENG. AND MIN. JOURN., June 24, 1916

BRITISH BROKEN HILL PROPRIETARY 1104

Abstract of report of directors for half-year ended Dec. 31, 1915, dealing particularly with the metals situation and the effect of the provisions of the Trading with the Enemy Amendment Act.

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PROPERTIES OF SLIME CAKES—II 1105

By E. E. Free

A final treatise on colloids as they occur in ore dressing. Porosity and its various phases are discussed, together with a note of the factors that increase or diminish it.

ENG. AND MIN. JOURN., June 24, 1916

CANADIAN MINERAL RESOURCES 1108

At a meeting of the Anglo-French Exploration Co. in London recently, J. B. Tyrrell spoke of Canada as a field for mining investment. The annual mineral production during the last five years has increased from £3,000,000 to £28,500,000. There is still a large part of the country which is unprospected.

ENG. AND MIN. JOURN., June 24, 1916

WHAT'S THE MATTER WITH LEADVILLE? 1109

This conservative camp is known for its variety of metal production. Pumping operations are opening up new depths of available mineral, and the camp is near the crest of a wave of prosperity. The answer is "She's all right." ENG. AND MIN. JOURN., June 24, 1916

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SMELTING AND SELLING AUSTRALIA'S BASE METALS 1120

Further details of the plan to smelt, refine and sell the important lead and zinc production of Australia through British channels. This is intended to eliminate permanently the German control of Australia's metals. It is expected that the lead concentrates will be smelted mainly in Australia, and the zinc in Great Britain, Belgium and France.

ENG. AND MIN. JOURN., June 24, 1916

SEMICENTENNIAL CELEBRATION OF CALUMET & HECLA MINING CO. 1122

Calumet & Hecla will hold a big party at Calumet, Mich., July 15, to celebrate the 50th anniversary of mining on its conglomerate lode. The plans include an all-day picnic for officers, employees and their families, with suitable addresses, parade and presentation of medals to old employees. If the weather is bad, an indoor program will be substituted. All employees will receive their full day's pay on anniversary day.

ENG. AND MIN. JOURN., June 24, 1916

WILL AMERICAN CAPITAL BE ATTRACTED TO THE FAR EASTERN RAND? 1124

By A. Cooper Key.

Discussion of details of report of R. N. Kotze, government mining engineer, on the Far Eastern Rand, which contains 250 sq.mi. of undeveloped gold-bearing territory which has just been investigated by W. W. Mein and associates for Adolph Lewisohn and allied interests.

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NUMBER OF COPIES PRINTED THIS ISSUE, 10,250

None sent free regularly, no returns from news companies, no back numbers.

An Old Advertiser's Advice to His Son in Business

Being No. 2 of a series of Sermonettes by the late John A. Hill written in 1903.

No, my son, I won't tell you the names of the papers that I think you ought to advertise in—that would be doing your work—but I'll tell you how I judge papers, and from that you may get a pointer on how to do the same.

Wouldn't it be foolish, say ten or fifteen years from now, for you to advertise in some paper "because father thought it was the best?"

You've got to judge the papers of the day.

Age is something that cannot be bought in a newspaper, and, other things being equal, the oldest paper in a line has an advantage—but age alone is weakness. People get into the habit of using a certain paper.

The paper that can hold its own and make enough of a show to get *new* readers in the *habit* of subscribing is a bird, and the one you need to get next to.

First of all, you are making a tool that is used only in engineering work—keep your ad in an engineering paper.

If a blanket sheet goes to ten thousand people that don't use your goods and to one thousand that do, you will get one reader for every eleven you pay for.

It would be cheaper to pay ten times the price for a straight engineering circulation of the same amount.

Papers that are read by possible buyers are the only ones that count, from your standpoint. Notice the amount of correspondence that shows an interest in the paper and a close reading of its pages.

You have a big list of papers sent you free—any old excuse will do—you don't read them regularly, if at all—it is safe to assume that other people are like yourself.

Again, always remember it is the ad in the paper that is read that counts. An ad that is not read is seed that never came up. It's human nature to put little value on things that cost little.

Is there a paper in the business that you feel *you must* read every week to keep posted, that you are just *afraid* to miss a number of? Well, that is the paper that can carry your notice where it will be seen.

When you see a trade or technical publication printed on coated paper, rest assured that it has a small circulation. Trade papers of circulation cannot afford to use coated paper any more than Uncle Sam can afford to furnish sealskin overcoats for his soldiers.

Advertise in papers that have other advertisers in your line. Keep in good company.

Keep out of papers that are free with the puffs. They will give a hundred dollar p.ff to your competitor whom t ey hope to get and nullify the sixty-dollar ad you are paying for.

Your advertising is part of your selling force—make it as respectable as your other salesmen.

Now, this next paragraph may seem funny, but let its truth sink deep in your soul.

The paper that spends time and money to interest its readers and is very, very chary about using any puffs or write-ups for you or any other advertiser is the paper to tie to.

If it even has the reputation of being mean about notices, stick and put in your best puff in your regular space. That's the paper that is read, and read by people who know an advertisement in disguise as well as they do a technical article.

A puff is like an uninvited guest at a banquet.

The publisher and editors of such a paper are not in cahoots with your competitor, that they won't use your puffs—they are afraid to, they fear the reputation of their publication with readers, and they know just enough about the business to know that, in the end, the paper can do good to advertisers just in proportion to its standing with readers.

Of course, there are exceptions. I've known barbers to pose as Italian dukes—for a time. But they didn't work regularly at duking very long.

Figure it this way: I want to reach a certain class of men. They are busy—won't read one circular in ten. They are so busy they won't read over one or two trade papers, and those the ones they can learn most from.

Plant your seed right there, keep the weeds off, and the sunshine and rain will make something grow—not tomorrow, but next fall. Heaven itself cannot produce a three-year-old colt in a minute—don't expect miracles of the newspaper.

THE OLD MAN.

Snappy Blows

Theodore Roosevelt has often said that he has no love for the man who "hits soft." It depends on your point of view as to whether you agree or disagree with him. One thing sure—you have no love for a drill that hits soft. That being the case, the

NEW Cleveland POCKET-IN-HEAD Stoper

should be a drill after your own heart **because it hits hard, snappy blows like the crack of a pistol.**

The "New Cleveland" is a hard hitter because of an unusual feature possessed by no other drill—the air pocket-in-the-head. It holds twice the air needed to supply the piston chamber. The moment the valve shifts, a full supply at line-pressure rushes in behind the piston, resulting in greatly increased starting speed of the piston, higher velocity throughout the stroke and more blows of the snappy kind.

This is one of the biggest improvements made on rock drills in recent years and is one of the reasons why we are able to guarantee that the "New Cleveland" will cut your drilling cost 50 per cent.

We don't ask you to take our word for its cutting capacity, low air consumption, or low repair cost. All we ask is a trial, at our expense, of a "New Cleveland" in your mine. If it fails to meet our claims, send it back and it will cost you nothing.

Why not hit the first blow towards reducing your drilling cost by sending in the coupon?

The Cleveland Rock Drill Co.

Cleveland 6410 Hawthorne Avenue Ohio

New York—30 Church Street.
Ishpeming, Michigan—P. O. Box 234.
Denver, Colo.—1633 Tremont Street.
Salt Lake City, Utah—811 Walker Bank Building.
Sacramento, Calif.—P. O. Box 351

Canadian trade supplied by
Cleveland Pneumatic Tool Co., of Canada, Limited,
Toronto, Ont.

Sign This Coupon—Tear It Off—Mail Now.

Mail Bulletin No. 35 and trial order blank to.....

Name .....

Address .....

Position .....

Name of Mine .....

City .....

State .....

6-24-16

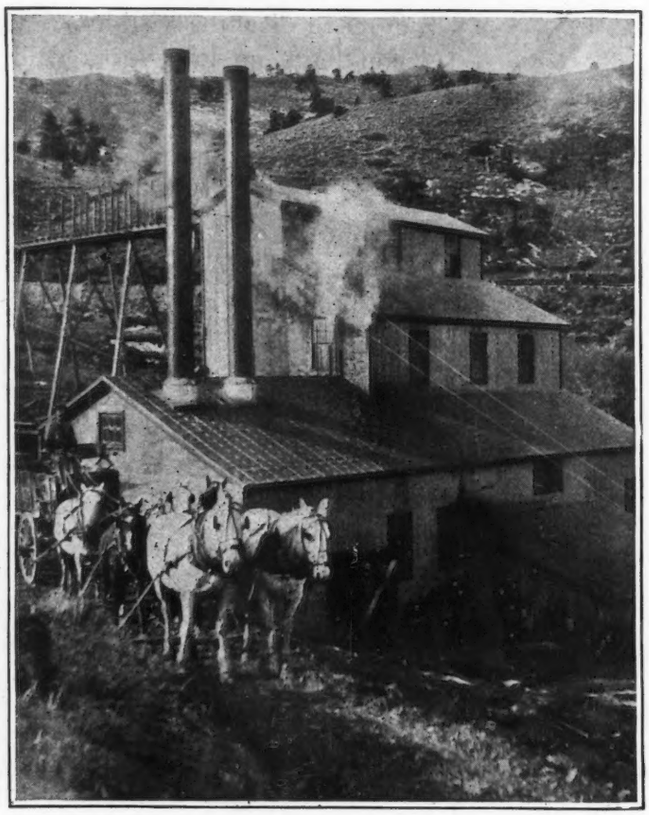
WHAT KIND OF ROOFING DO YOU USE?

Is it Weatherproof?

Genasco is!

Will it Rot, Crack or Dry Out?

Genasco Won't!



This 20 Stamp Mill recently built by us is entirely covered with "Genasco."

Genasco is a Ready Roofing made of the genuine Trinidad Lake Asphalt and Wool Felt, saturated with asphalt.

As asphalt is a natural weatherproofer, so also is "Genasco" weatherproof.

It is not effected by heat or cold, or by acids, alkalies, gases, fumes or vapors. It can be laid by anybody, and is easily repaired in case of accident. It gives about double the service for half the cost.

The Kant-leak Kleet used in applying "Genasco," adds to its satisfaction and economy. They take the place of the old-fashioned roofing nails and cement, and insure the perfect lasting application of roofing.

May we send you free samples of "Genasco?"

HENDRIE & BOLTHOFF MFG. & SUPPLY CO.
DENVER, COLO.

Announcement

The New Deister SIMPLEX Rougher
New Deister SIMPLEX Finisher
Deister SIMPLEX Slimer (Single or Double Deck)
and Deister Cone Baffle Classifier

embody all the very latest DEISTER inventions and improvements in

Concentrators and Classifiers

They are positively the best machines on the market today.

This was impressively demonstrated in a recent competitive test at the Alaska Juneau Gold Mining Company's test plant at Juneau, Alaska. Our Simplex Rougher handled 225 to 250 tons per day, at the same time producing a clean concentrate. Our Simplex Finisher handled 75 to 100 tons per day, making a clean concentrate and low tailing. Both machines require very little dressing water considering the tonnage treated. Our Cone Baffle Classifier handled 115 tons per day using only 12½ gallons of water per minute.

As a result of this test we received the order for all concentrating tables and classifiers in their new 10,000-tons mill, consisting of 48 Roughers, 102 Finishers, and 72 Classifiers.

The Alaska Treadwell Gold Mining Company tested our Double Deck Simplex Slimers, each machine treating 50 tons per day successfully; this being equivalent to four Vanner loads in their mills.

NOTE: the reason for this large capacity, small amount of dressing water and automatic control of the line of separation on our New Simplex Tables, resides in our patented **DUPLEX PLATEAU** which consists of **several steps** or **rises** along a diagonal line intermediate the dressing zone and the main concentrating portion of the deck.

We are constantly receiving **repeat** orders. This proves that the Mill Men consider our Plateau feature a great improvement.

The following are some of the users of our Simplex Machines: Inspiration Consolidated Copper Co., Miami, Arizona; Miami Copper Co., Miami, Arizona; Hollinger Gold Mines, Ltd., Timmins, Ont., Canada; United States Stores Co., Salt Lake City, Utah; Smuggler-Union Mining Co., Telluride, Colorado; Granby Mining & Smelting Co., Granby, Missouri; Alaska Treadwell Gold Mining Co., Treadwell, Alaska, and others.

Remember the **DEISTER SIMPLEX** tables are the only ones that embody the **latest** Deister inventions. **Look for the DEISTER SIMPLEX** in all our advertisements.

We wish to make clear to all who are not intimately acquainted with the personnel of the Deister Machine Company, that Emil and W. F. Deister are exclusively and permanently engaged with this company. These men are co-operating with our engineering force and are equipped with years of field experience in the concentration of ores. Write us freely. It may be that we can assist you. We have machines working on all kinds of ore.

Send for our **latest DEISTER SIMPLEX** catalog or give us a trial order.

DEISTER MACHINE COMPANY

INCORPORATED JULY, 1912

Home Office and Factory:—1933-2003 East Wayne St., FORT WAYNE, IND., U.S.A.

London Office:— No. 1 London Wall Bldgs. LONDON WALL, E. C.

AGENTS

WILLIAM L. REEDER	**410 Consolidated Building**	**JOHANNESBURG, S. AFRICA**
TAKATA & COMPANY	**2 Yeiraku-cho, Nichome, Kojimachi-ku**	**TOKYO, JAPAN**

"Perfect"

Wire Cloth may not seem important but surely Sizing does—

Judge the importance of a product, not by what it is, but by what it does.

To the mine manager or mill superintendent harried with a hundred executive worries, the question of using "Perfect" Double Crimped Wire Cloth may seem a minor one—one that can be taken up on some "off" day, BUT—

The question of using "Perfect" Wire Cloth is an important one because it means more uniform sizing.

Count upon "Perfect" Wire Cloth for as long wear as any other similar product gives you, but, in addition, count upon it for more uniform sizing.

This is because of the double crimp feature of "Perfect" Wire Cloth which prevents slippage and insures even wear.

Will you give it a little thought—now?

It will not take more than a minute-and-a-half of your time to jot down a request for the "Perfect" Wire Cloth Book which is replete with information about wire cloth and general screening facts.

Another point we don't want you to forget is the variety in which you can get "Perfect" Wire Cloth —from ½-inch steel bars down to 200-mesh brass cloth for chemicals.

THE LUDLOW-SAYLOR WIRE CO.

General Office and Factory - - - St. Louis, Mo.

Branch Offices: 10 East Jackson Boulevard, Chicago
Mills Building, El Paso, Texas
Felt Building, Salt Lake City, Utah

DEWCO Crushing Rolls are Built for Service

Fig. 853—36 x 16 rolls—with springs

NOTHING but experience—15 years of it in building crushing rolls—could give our machine so many points of superiority. Here they are—every one of them imparting its share to the sturdy service that has made our Crushing Rolls famous:

All adjustments can be made without stopping Rolls: Distance between Roll Shells adjusted by worm gear and crank; Lateral Adjustment of Shaft; Swivel bearings, self-aligning, no cramping of shaft in bearing when one side of Roll opens more than the other; Bottom of frame, as well as top of frame, machine finished; Bronze Bushings; Grit Proof Bearings; Journal boxes interchangeable, Shafts ditto, and also with Rigid or Spring type; very large shafts and journal boxes, insuring longer life and a higher speed than with the ordinary Rolls; Renewable wearing plates under sliding pedestals; Shafts removed without disturbing tension bars or springs; all large nuts are clamp nuts, small ones self-locking; Rigid and Spring Roll parts interchangeable and requiring therefore only one set of spare parts.

Bulletin 1046 *tells the whole story. Send for it.*

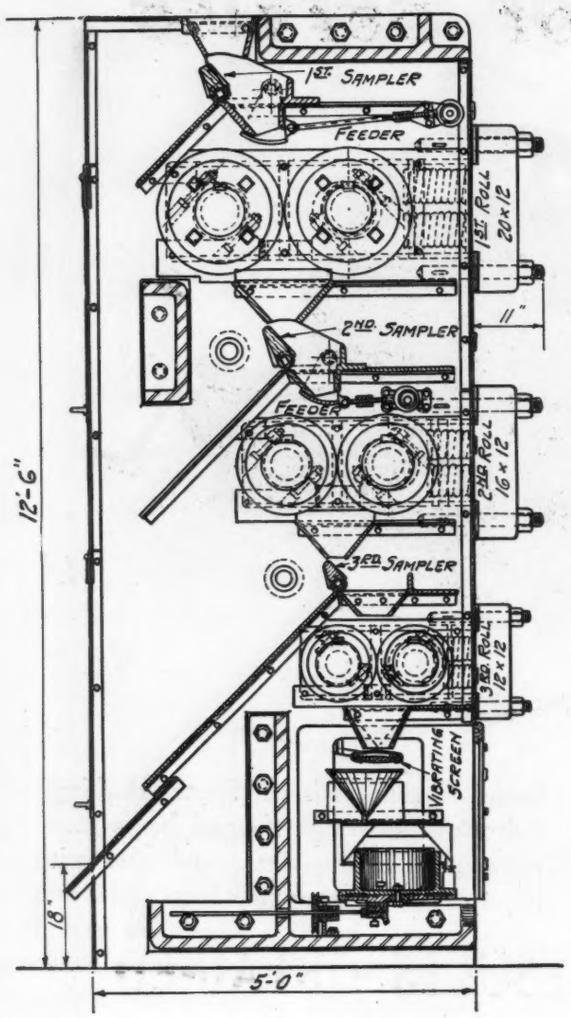
THE DENVER ENGINEERING WORKS CO. Denver Colo.

Electric Hoists
Richards Pulsator Jigs
Richards Pulsator Classifiers
Ore Crushers
Ovoca Classifiers

Crushing Rolls
Mine Cages
Stamp Mills
Tube Mills
Mine Timber Framing Machinery

Revolving Screens and Grizzlies
Automatic Samplers
Sample Grinders
Ore Buckets

"THREE IN ONE"



Sectional View

CLIFT'S AUTOMATIC CRUSHING
AND
SAMPLING MACHINE

There is a bulletin.

CLIFT'S
AUTOMATIC CRUSHING

AND

SAMPLING MACHINE COMBINES THREE SAMPLERS

WITH

THREE SETS OF ROLLS

IN

ONE MACHINE

It prepares your sample for the laboratory, eliminating the personal equation from all operations.

IT COMBINES

Less Room, Less Power, Less Labor, Less Time and Less Cost

with

GREATER ACCURACY

TRAYLOR ENGINEERING & MFG. CO.

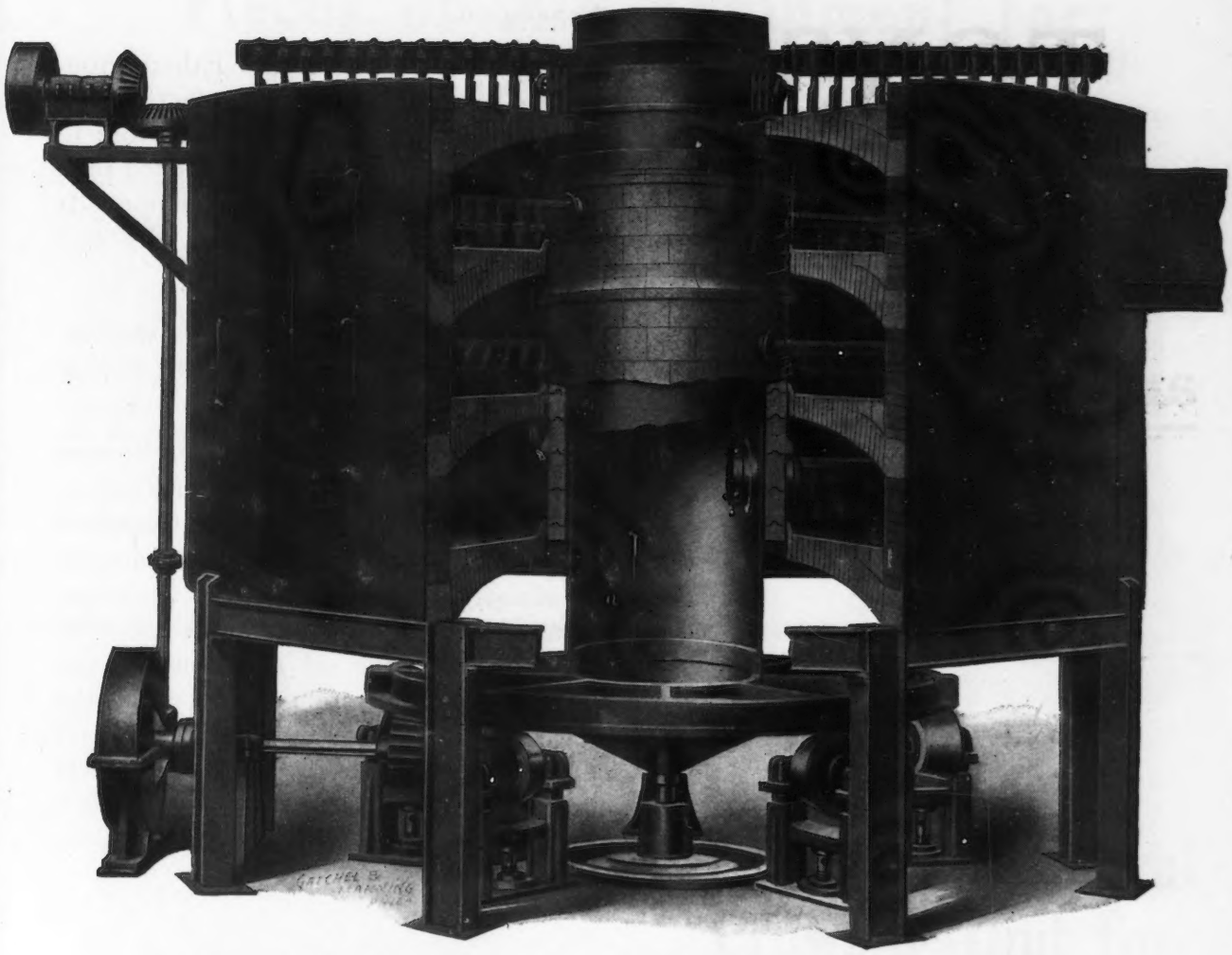
NEW YORK OFFICE:
26 Church Street

MAIN OFFICE AND WORKS:
ALLENTOWN, PA., U. S. A.

WESTERN OFFICE:
Salt Lake City, Utah

The Wedge Mechanical Furnace

Patented



TWO DESIRABLE RESULTS OBTAINED

First, Wedge Furnaces are built in different types adapted to different problems; therefore you secure the calcine desired.

Second, the mechanical construction of the machine insures continuous operation and reduced repair costs.

There are no cast-iron shafts in Wedge Furnaces. The only metal parts exposed to the heat and destructive gases are the arms, rabble blade holders and rabble blades.

Write us stating analysis of ore, concentrates, mixture or material you desire to roast, characteristics and physical condition of same, number of tons to be treated per twenty four hours, and results desired in the calcine.

Wedge Mechanical Furnace Company

Greenwich Point, Philadelphia

10 TONS Roasted in 3 Hours and 45 Minutes

This was done with an Etherington-Singer Roaster recently by a large zinc company while making a test run. A cut of the Roaster is shown below. It is a part of the Campbell System of Magnetic Separation.

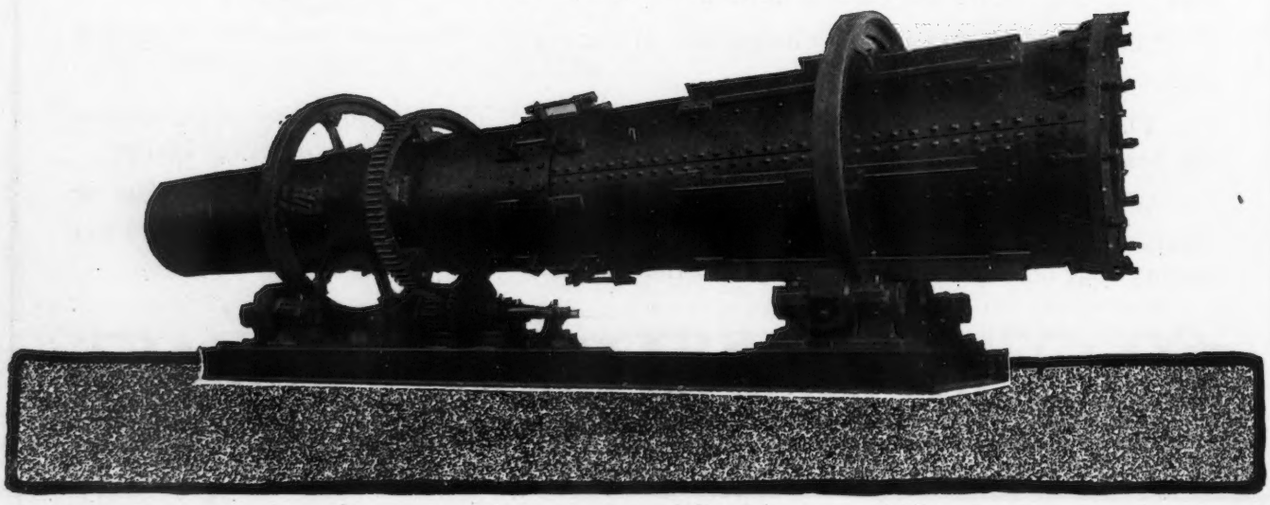
The great capacity of the Etherington-Singer Roaster is due to the fact that it takes but a few minutes for the ore to pass through it. Heat is produced in it by a non-oxidizing fuel oil flame. It takes but 10 minutes to heat, dry and roast the ore.

This Roaster assures an even magnetization which is so essential for clean separation.

A complete unit of the Campbell System consists of an Etherington-Singer Roaster, a cooling device, and three Campbell Separators. This system is in operation on zinc-iron sulphide ores and chalcopyrite. Also operating successfully in conjunction with the oil flotation process. The Campbell System produces at the lowest cost the greatest percentage of metallic contents of ores and the highest grade of zinc concentrates. Let us furnish convincing figures and full particulars.

The Zinc Concentrating Co.

Boston 60 Congress Street Mass.



Two Particularly Attractive Pieces of Mill Equipment for Particular Ranges of Service

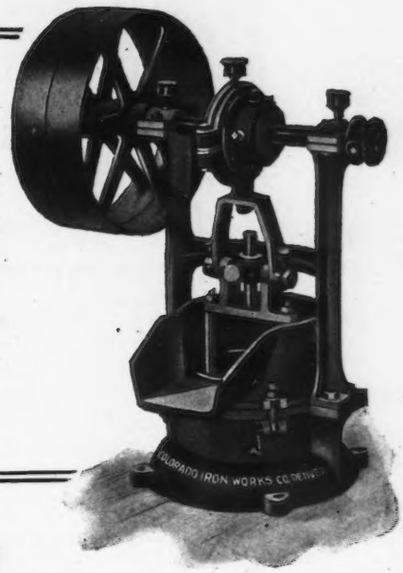
The Colorado Diaphragm Pump

The Ideal Slime Pump

where the lift does not exceed 10 or 12 feet

With it, there is practically no wear and tear, minimizing upkeep costs to an unequaled point. The pump operates at slow speed and is easily regulated to an exact discharge, an advantage that will be readily appreciated by the mill operator.

There is no rocking motion to the diaphragm with the Colorado Diaphragm Pump as is ordinarily the case with pumps of this type, hence no rapid deterioration. Write for descriptive leaflet.



This Grinding Pan

A Most Economical Crushing Unit for Small Operators

If you have to crush from 10 mesh down to not more than 150, and have a tonnage of from 7 to 14 tons to handle, you will do well to investigate this grinding pan.

Under these conditions, it does the work of a tube mill, at a fraction of the initial outlay and also at equally low operating cost. Write.

COLORADO IRON WORKS COMPANY

-1860- DENVER COLORADO -1916-

THE PLUMB PNEUMATIC JIG is particularly well adapted to the concentration of tungsten, especially low grade.

Have us test your ores for commercial recovery of values at our Denver Laboratory before you install machinery.

Our laboratory is fully equipped with all modern processes including the *Huff Electrostatic Separator*, the *Plumb Pneumatic Jig* and *oil flotation*.

As a branch of the American Zinc, Lead & Smelting Company, we have had a very wide experience with zinc and lead ores.

Write

American Zinc Ore Separating Co.

1218 Foster Bldg., Denver, Colo.

THE "STOPEHAMER"

There is great satisfaction in knowing—that when an Ingersoll-Rand Stopehamer goes underground, the next trip of the cage will not find it on top for repair—nor many trips to come.

The many records of sustained efficiency and economy being made with Ingersoll-Rand "Stopehamers" by many users are possible, because–

THE STOPEHAMER IS BUILT RIGHT

Bolted Construction,
Single Throttle Control,
Correctly Balanced,
Easily Rotated,
Minimum Number of Parts, all easily acce ssible.

Extra Long Chuck,
Renewable Anvil Block Bearing
Simple Air Strainer,

Drop Forgings and High-Grade Steel Throughout.

When you buy a STOPEHAMER, you reimburse yourself in a very short time, the purchase price, in the attainment of more efficient service and greater economy.

Bulletin No. 4036, sent upon request.

INGERSOLL-RAND COMPANY

11 Broadway NEW YORK *Offices the World Over* **165 Q. Victoria St. LONDON**

For Canada, address Canadian Ingersoll-Rand Co., Montreal

AIR COMPRESSORS ROCK DRILLS SHARPENERS

17-SD

Butchart Concentrating Tables Treat All Classes of Material

Coarse Sands **Fine Sands** **Slimes**

By using suitable modifications of the standard system of riffling, any table can be made to handle any class of feed in the mill. As a slimer it has no equal.

Price $400.00
f.o.b. Denver

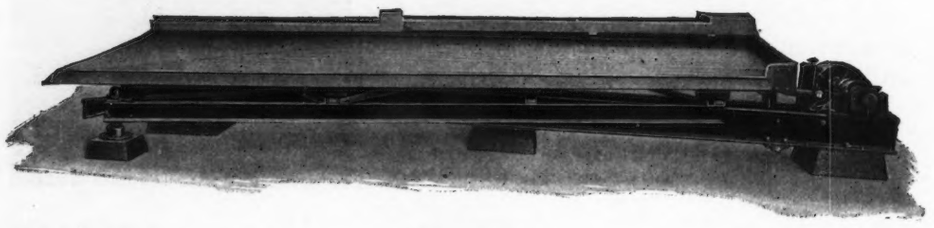
THE driving mechanism, being completely inclosed and self-oiling, requires little attention; the heavily reinforced frame insures a permanently true deck, without repairs; the screw-operated tilting mechanism provides easy, quick and close regulation.

Write for Bulletin No. 2. Submit your concentration problems.

W. A. Butchart 605-607 Mercantile Bldg., Denver, Colo.

—CLEAN CONCENTRATES—

The Dependable Tables
The New Deister-Overstrom



ROUGHER ***FINISHER*** ***SLIMER***

Low Tailing ***Low Upkeep***

Our experimental plant and the services of our experts are at your service for working out your table problems. **Write us today.**

The Deister Concentrator Company

Manufacturers of DEISTER and OVERSTROM Tables in either Single or Double Deck Types

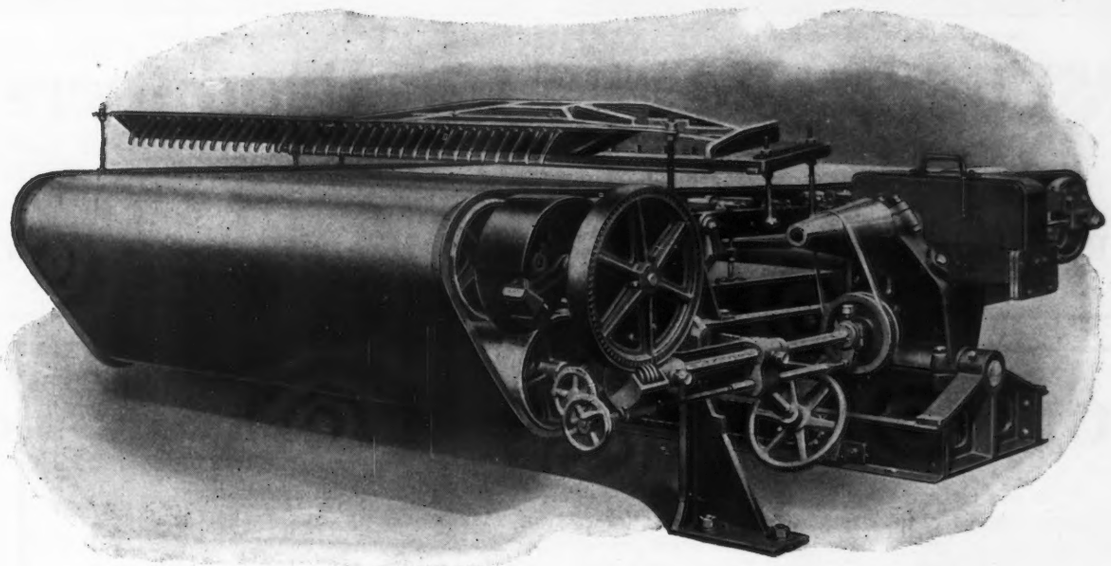
Main Office, Factory and Test Plant—Ft. Wayne, Ind.

Denver Office, 1718-1720 California Street **San Francisco Office, 75 Fremont Avenue**

Vanner Practice is Often Bad

Shut-downs, feed changes, machine adjustments, all mean variation in saving as well as capacity, and it is unquestioned that the plant whose final concentrators require the least attention makes the greatest total saving, other things being equal.

Mechanical Effectiveness Counts



The ISBELL VANNER

embodies that effectiveness; its construction and arrangement are improved and simplified, thereby insuring a minimum of repairs. It is a 24 HOUR A DAY machine.

Ask for Bulletin 1801-A.

Allis-Chalmers Manufacturing Co.

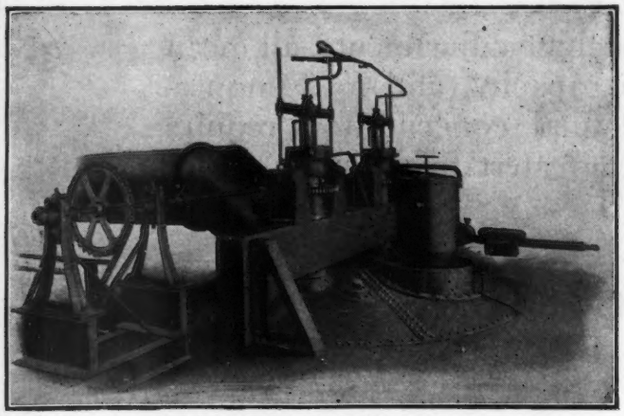
Mining Machinery Dept. - - Milwaukee, Wisconsin

Offices in All Principal Cities.

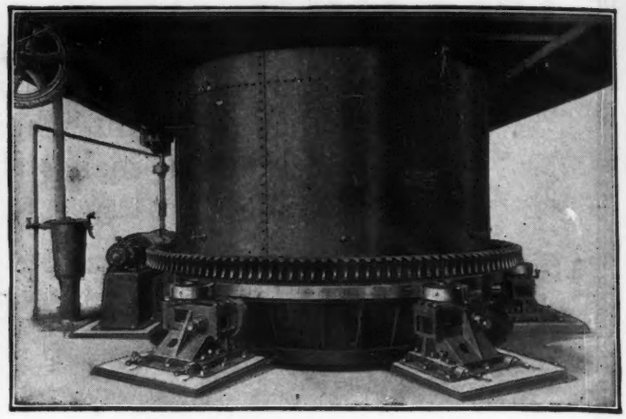
For all Canadian Business refer to Canadian Allis-Chalmers, Ltd., Toronto, Ont., Canada

REDUCED OPERATING COSTS

will follow the use of these producers in connection with your smelting and roasting furnaces.



Stationary Section, with Stirring Gear.



Revolving Section, with Worm Gear Drive.

"The Wood Mechanically Operated Gas Producers"

excel in economy and quality of the gas, and effects a large saving in labor, as no hand poking is necessary even under continuous maximum production. One producer gasifies 3,330 lbs. of coal per hour, and the gas contains from 26 to 28% CO.

R. D. WOOD & COMPANY, PHILADELPHIA, PENNA.

Makers of Centrifugal Pumps, Cast Iron Pipe, Fittings, Valves and Special Castings.

OTTUMWA High Efficiency Electric Hoists

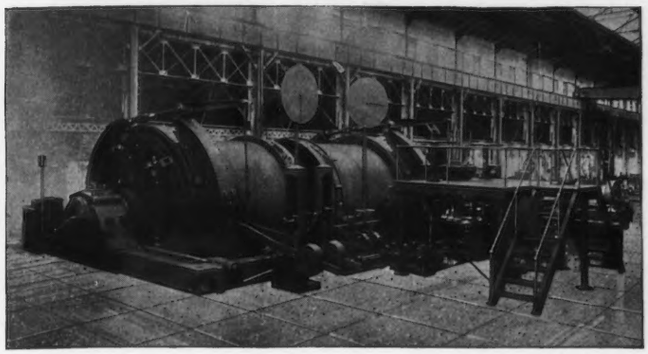
You can reduce your power cost by this design of Electric Hoist. It also reduces first cost by making possible a smaller motor, consequently reducing the maximum demand charge. The brake is operated by oil under pressure, and is equipped with overwinding device, and automatic emergency application. We have a number of this type of hoist in operation from which we have received the highest endorsement as to their economy and efficiency.

If you are in the market for an electric hoist, write us giving full data requested on page 9 of our catalogue No. 30.

Electric Hoists from 5 to 50 H.P. in stock for prompt delivery.

Ottumwa Iron Works, Inc.
Ottumwa, Iowa

PATENT APPLIED FOR



Is that Sign "Safety First" Enough?

It is a good thing to post "Safety First" signs around your mine and head houses. Men cannot be warned too often to be careful.

But are signs enough? If they were, you might rest assured with any hoist, so long as a warning to be careful was placed alongside the engineer.

We Build Safety in the Hoist

That is, we leave as little chance for accident as is humanly possible. Just for instance, there may be only a limited amount of space between skip and head sheave at the end of the trip. In such a case special study must be given to the safety mechanism as the ordinary appliances will not serve the purpose. That is just an example of W-S-M attention to safety requirements.

More careful design and incorporation of thorough safety lifts the price of W-S-M Hoists somewhat higher than the ordinary hoists—but they are worth it. Investigate.

The Wellman-Seaver-Morgan Company
Cleveland, Ohio, U. S. A.

THE CASE Oil-Fired Furnace
One, Two or Three Muffles

The Case Improved

Oil-Fired Muffle Furnace (Front Control)

The *Latest Type of Assay* Furnace

A Dividend Payer

from the day it is installed

Carefully compiled records of results obtained together with the unqualified indorsements of enthusiastic purchasers in metallurgical fields everywhere, fully justify and substantiate our strongest claims for CASE OIL FURNACES.

CONSIDER THESE ADVANTAGES!

ECONOMY Utilization of all heat units in the oil through perfect combustion, gives lowest possible fuel consumption—saving 20 to 60% in fuel cost.

RAPIDITY Work is handled in the shortest possible time, muffles at fusion heat in 30 minutes. Puts "Speed" into the assay office.

EFFICIENCY By saving **fuel, time** and **labor** a **Case Oil Furnace** increases greatly the ratio of *results* accomplished to *energy* expended.

Write today for complete information and photograph.

The Denver Fire Clay Company

DENVER U. S. A. COLORADO

Flotation Concentrate

Varies so much in settling qualities that it is difficult, without making careful tests, to determine the amount of area required for each case.

We have made a careful study of settling and are equipped to make necessary tests as a convenience to those planning the installation of Dorr Thickeners.

If you are in doubt as to the settling area required, send us a 5-gallon sealed sample of your pulp to be fed to the Thickener, stating tonnage to be handled, and we will advise you as to its size.

Dorr Thickeners are used extensively for

Thickening dilute pulp to the right consistency:
Thickening the concentrate before filtration;
Recovering water for its re-use.

THE DORR COMPANY

Engineers

Successors to THE DORR CYANIDE MACHINERY COMPANY

NEW YORK
17 Battery Place

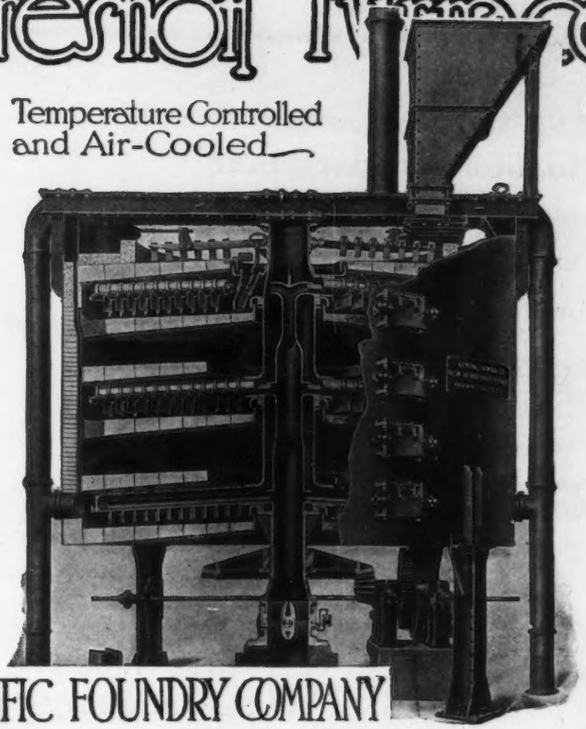
DENVER
Cooper Building

LONDON, E. C.
16 South Street

The New Herreshoff Furnace

for Roasting Ores
Patented

Temperature Controlled and Air-Cooled



What, exactly, is your roasting problem? Does the difficulty lie in getting exactly the roast desired or is your present cost of roasting too high?

The secret of the efficiency of the Herreshoff lies in the cooling system. It permits the most rigid control of the temperature on every hearth. The exact degree of heat desired to get any result from partial to dead roasting on any material treated can easily be **attained and maintained** precisely.

Add to that a pre-heated blast, with its advantages, the high capacity of the Herreshoff as compared to other furnaces, and the construction that makes operation so simple and cuts the cost of upkeep to the lowest possible point.

Our engineers will be glad if you will furnish data, to suggest an installation that will solve your roasting problems.

GENERAL CHEMICAL COMPANY
Herreshoff Furnace Department
25 Broad Street New York, N. Y.

PACIFIC FOUNDRY COMPANY
18th and Harrison Streets San Francisco California
Pacific Coast Agents

Single Friction Drum Electric Hoist

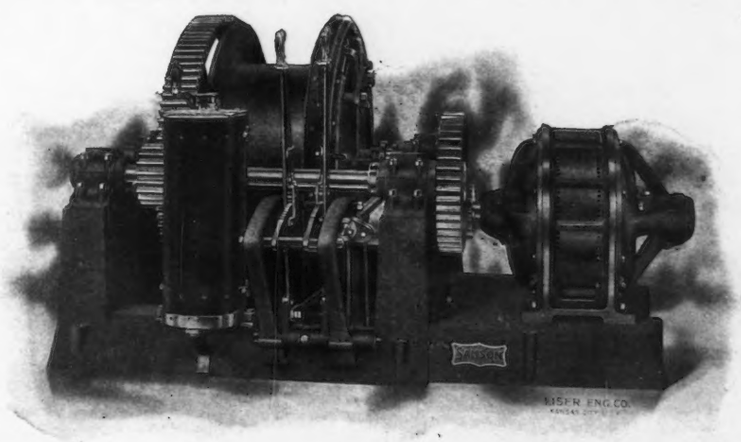
THE Hoist illustrated is not the smallest nor the largest Electric Hoist of this type we build, Single Drum and Double Drum.

These Hoists have side frames high enough to permit gears clearing the floor; the frames are sectional. The sub-base for motor is machined and carefully fitted to main frame of hoist.

Gears are steel, accurately cut from solid metal on automatic machines; motor pinions are rawhide. Gear guards made of heavy steel bands are furnished. The clutch and brake bands are lined with thermoid, a composition which has a smooth and steady release and will outwear any wood brake liner made.

These Hoists are designed and built for the most severe service.

The Motors are Alternating Current or Direct Current as may be required.



5000 pounds Rope Pull, 300 feet per minute, 52 H.P. Induction Motor.

Our new Hoist Catalog mailed upon request.

The English Iron Works Company, Kansas City, Mo., U. S. A.

Fast Cutting—

Hardsocg Drills have cut out a solid reputation for good work and lots of it. Their success resulted from deep study of the exacting demands made upon drills in the average mine and quarry.

No. 66 "Wondersinker"

This hand drill is cutting more feet of holes per day, considering its weight and price, than any other drill made. A comparative test will prove the truth of this. Splendid construction, together with a wide knowledge of drill needs has made the No. 66 "Wondersinker" the very last word in drill efficiency. It is self-rotating, automatically oiled, has exhaust control, shock absorber, few parts and remarkably low air consumption. A free trial will quickly prove its merit. Bulletin No. 57 explains each feature. May we send it?

Weighs 40 Pounds

Hardsocg Wonder Drill Company
Ottumwa, Iowa

8 reasons why the CEMENT-GUN belongs in *your* equipment

1. **Lines drifts** or other horizontal workings in which rock tends to slack or otherwise fall off.
2. **Lines a shaft alone** or in conjunction with other mixing outfits.
3. **Repairs concrete work** of all kind. Bring the Cement-Gun to the rescue wherever concrete has cracked, crumbled or split.
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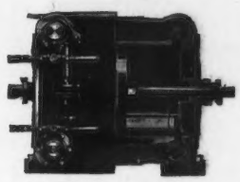
5. **Coats mine timbers for** protection from fungus, bad water and rot.
6. **Waterproofs concrete dams** and retaining walls. Seals up water-bearing fissures.
7. **Fireproofs** timber bins and other mine structures.
8. **Puts fire and weatherproof coatings** on structural steel without use of forms.

Just write for a copy of the Cement-Gun Bulletin, which has further details and explains fully how everything is done.

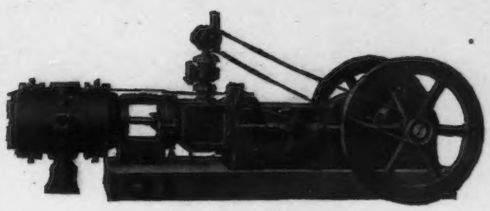
Cement-Gun Company, Inc., South 10th and Mill Streets Allentown, Pa.

New York Office - - 30 Church St.



Steam Cylinder
for Corliss Compressor

Laidlaw Feather Valve



Single-Stage Steam-Driven
Feather Valve Compressor

A Winning Combination

Compressed air users have warmly welcomed the supremacy of the Feather Valve in combination with the foremost air compressor.

That is why a year's marketing of the Laidlaw Feather Valve Compressor has taxed the capacity of the Laidlaw Plant to the utmost.

LAIDLAW

FEATHER VALVE AIR COMPRESSORS

The Valve: Leads in simplicity, durability and efficiency.

The Compressor: Sturdily constructed of excellent material—highest refinement of design in the smallest machine, as well as in the largest.

Compare point by point, the specifications of the Laidlaw Feather Valve Compressor with those of any competing line.

Full details in Bulletin L-530. Copy on request.

WORTHINGTON PUMP AND MACHINERY CORPORATION
Successor to International Steam Pump Co.
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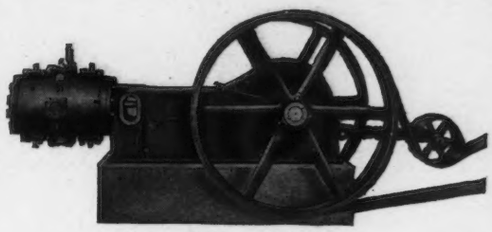
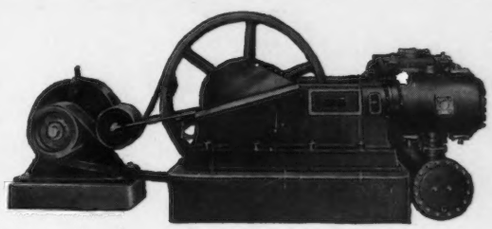
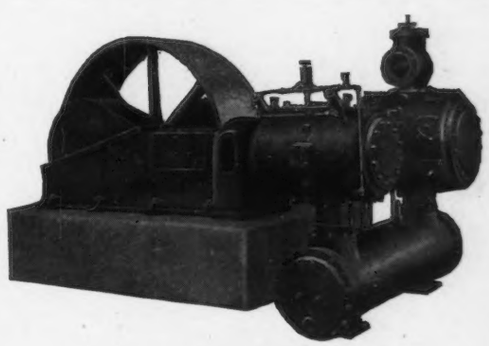


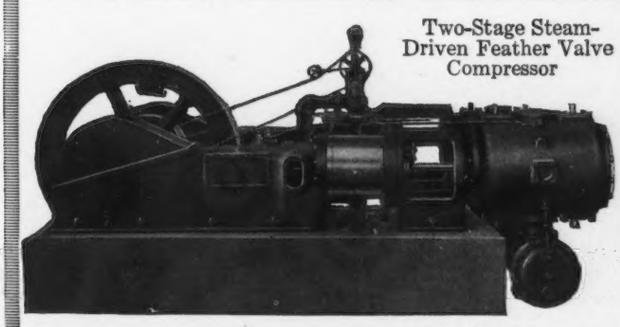
Single-Stage Belt-Driven
Feather Valve Compressor



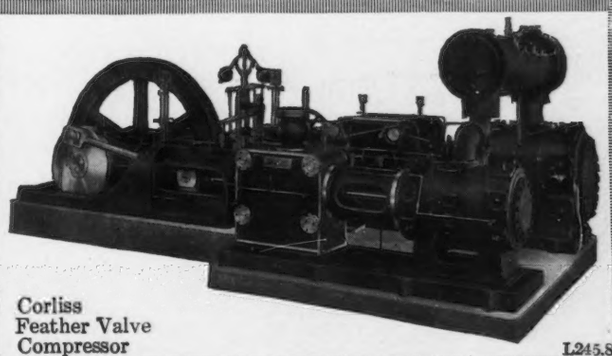
Two-Stage Motor-Driven
Feather Valve Compressor



Two-Stage Belt-Driven
Feather Valve Compressor

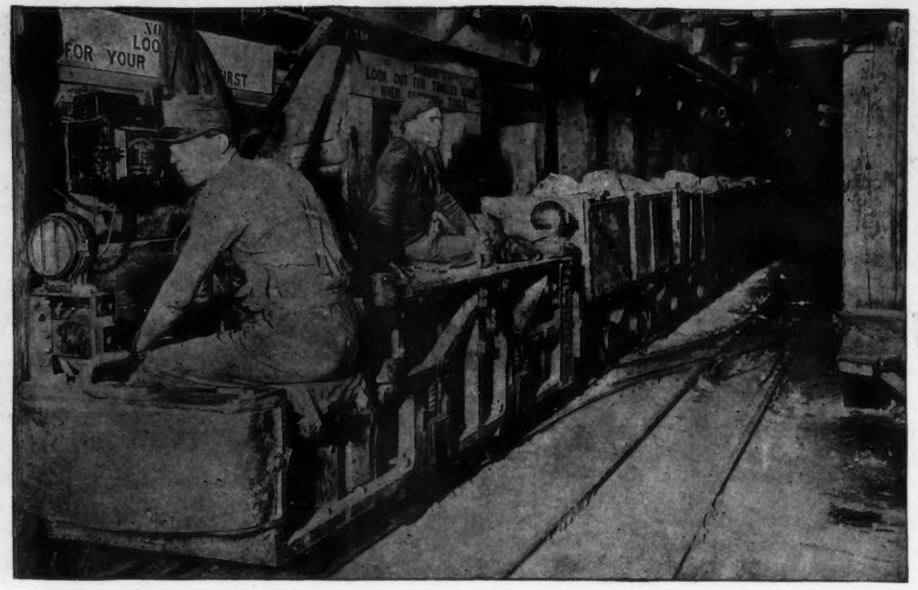


Two-Stage Steam-
Driven Feather Valve
Compressor



Corliss
Feather Valve
Compressor

L245.8



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4. We manufacture and furnish complete electric mine equipments, locomotive —power—and trolley line material.

One Contract One Responsibility
Means More Real Value for the Price

The Baldwin Locomotive Works
Philadelphia, Pa.

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East Pittsburgh, Pa.

It's the Cost of Replacing—

and repairing pipe lines that piles up cost in mines where acid water is encountered.

Our "Kemetaline" Acidproof Valves, Pipes and Fittings

have been solving this difficulty in some of the largest copper mines in the world.

The entire inner surfaces of the pipe and fittings are lined with a substantial acid-resisting lining that is attached by a special process which practically welds it to the pipe itself. It cannot be removed except by melting. The protection is complete—no part of the iron can come in contact with the water.

The valves are lined with a patented acidproof metal, which positively resists wear, abrasion and cutting action of the water. Furnished gate, angle or Y pattern.

Write for interesting Catalog describing our lined pipe and fittings of all kinds.

United Lined Tube & Valve Company
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The valves you install now should be in service for many years to come. Your close attention to details of construction, materials and workmanship (the factors which determine the life of valves) will play an important part in future dividends. By using

LUNKENHEIMER "Victor" Gate Valves

the valves "built for service," the installation will be permanent and satisfactory service is assured.

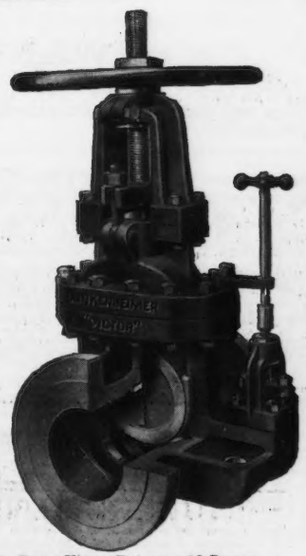
They have a single, solid wedge disc, finished to the exact taper of the seat rings which are *threaded* into the body—the type which has proven the most satisfactory.

The disc is guided by ribs cast in the body and travels to practically a closed position before coming in contact with the seat ring faces.

This prevents "dragging" across the seat ring faces when the valve is being opened or closed, which is the cause of most wear in Gate Valves.

When wide open, the top of the disc forms a seat under the bonnet, relieving the packing from pressure, and permitting of repacking while valve is under pressure.

All bearing parts are bronze bushed to prevent corrosion and give long life to the valve.



Extra Heavy Pattern with Bypass.

Made with Inside Screw Stationary Stem and Outside Screw and Yoke Rising Stem, in Bronze, Iron, "Puddled" Semi-steel and Cast Steel, for pressures up to 350 pounds and temperatures up to 800 deg. Fahrenheit

Write for descriptive literature.

THE LUNKENHEIMER CO.
—"QUALITY"—

Largest Manufacturers of High-Grade Engineering Specialties in the World

CINCINNATI

New York Chicago Boston London

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Make Screw Thread Joints with SMOOTH-ON Iron Cement No. 3

Joints Never Leak Under Any Pressure

Apply Smooth-On Iron Cement No. 3 to the screw threads the same as red and white lead. The great advantage of Smooth-On is that it expands in hardening and so closes up any defective places which would ordinarily cause leaks.

Free Instruction Book

Every one of the hundreds of uses for Smooth-On is explained in Smooth-On Instruction Book No. 15. Write for your free copy today.

Smooth-On Mfg. Co., Jersey City, N.J., U.S.A.

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BISMUTH METALLURGIST—a man experienced in the extraction of bismuth from ore is wanted; state full particulars of experience, give references. P290—Eng. & Min. Journal.

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THE UNDERSIGNED plans and conducts correspondence for positions in technical, manufacturing and professional lines for $2500 to $15,000 men exclusively. Complete privacy assured. No commission charged—only service fee and postage. Send name and address only, in confidence, for prefatory details. R. W. Bixby (established 1910), W1 Niagara Square. Buffalo. N. Y.

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ASSISTANT MINING ENGINEER (26), technical graduate with several years' practical experience in difficult shaft sinking and construction work, desires change. PW291—Eng. & Min. Journal.

MINING ENGINEER, married, technical graduate, 11 years' experience surveying, drafting, mining, construction, repair and maintenance, desires position, moderate salary. PW281—Eng. & Min. Journal, Chicago.

EXPERIENCED SMELTER FOREMAN wants position; can handle lead or copper furnaces, also copper converters, acid or basic method; age 38; best of references; fluent Spanish. PW297—Eng. & Min. Journal, Chicago.

ENGINEER (35), technically educated in civil and mechanical engineering; ten years' experience in civil engineering design and construction work; two years as chief engineer of large copper mine. PW306—Eng. & Min. Journal.

FURNACEMAN, many years' experience on copper blast furnaces with the Anaconda Co. thoroughly familiar with all details, now employed but desire change. PW300—Eng. & Min. Journal, Chicago.

GRADUATE COLUMBIA SCHOOL OF MINES, five years' experience mining, milling and assaying, two years executive in industrial work, desires position preferably in or near New York, where combined technical and business experience will be of value. Now employed. American, thirty years old, married. Speaks Spanish. PW303—Eng. & Min. Journal.

METALURGIST desires position as superintendent or assistant superintendent of a lead or copper smeltery; 15 years' chemical and metallurgical experience; at present employed. PW287—Eng. & Min. Journal, Chicago.

MINING SUPERINTENDENT desires position in charge of opening up new property; mining engineer of 14 years' practical experience; efficiency and cheapness of operation a specialty; copper, zinc, lead. phosphate, gold; interview Boston or New York. PW292—Eng. & Min. Journal.

MINING ENGINEER of the highest standing, who has traveled extensively and reported on properties in Asia, Africa, North, Central and South America, desires to form a connection, in consulting capacity or for work in the field, with an organization contemplating mining investments abroad. PW295—Eng. & Min. Journal.

MANAGER OF MINE OPERATING in Mexico, that has paid dividends through entire revolution, wishes change; young man, broad experience and best references from present employers. PW299—Eng. & Ming. Journal, Chicago.

TECHNICAL AND ANALYTICAL CHEMIST, age 30, experienced in electrometallurgy, handling furnaces and men, formerly chief chemist of large smelter now department superintendent, in present plant 6 years. PW301—Eng. & Min. Journal, Chicago.

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PRIVATE LESSONS, how to use microscope, wanted by young mining engineer; residence in Hoboken, N. J. W302—Eng. & Min. Journal.

FOR SALE

SULLIVAN DIAMOND CORE DRILLS—1 "B" drill, 1 "C" drill, 1 "H" drill, all with hydraulic feed; 1 "S" drill with screw feed; all in first-class condition. Address P. O. Box 33, Pittston, Penn.

TWO WOODBURY JIGS with slime classifier complete and in first-class condition; all parts and connections as good as new. FS284—Eng. & Min. Journal, Chicago.

INGERSOLL-RAND JACKHAMER rock drill, butterfly valve, operating on steam or air; good condition. FS280—Eng. & Min. Journal, Chicago.

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2 six-foot Chile mills, 2 9x15 crushers, 3 electric locomotives, 4 steam locomotives, 100-h.p. S.D. electric hoist, 150-kw. G.E. 2,300 V. 3 P. generator, Pelton 4-ft. wheel with governor, 4 Ry. steam shovels, new copper furnace, Connersville blowers 2 to 81-ft. contractor's hoisters, derricks, compressors, lighting plants, Corliss engines up to 800 h.p., boilers and pumps, 7 electric and 14 steam mine hoisters. Write for prices and details on this slightly used machinery and save money.

Arthur D. Kenyon, Denver, Colo.

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Mining Machinery
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1—16x36 Davis, D. D.
1—22x36 Danville, D. D.
1—28x72 Webster-Camp & Lane Double Cylinder Corliss Double Reel.

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1—5½x5 Anaconda, D. C. S. D.
2—6x8 Vulcan, D. C. S. D.
1—8x10 McFarlane, D. C. S. D.
1—8½x12 Webster, D. C. S. D.
1—10x10 Lidgerwood, D. C. S. D.
1—10x14 Davis, D. C. S. D.
1—12x14 Vulcan, D. C. S. D.
1—12x14 Fairbanks-Morse, D. C. S. D

FRICTION HOISTS

2—6x8 Vulcan, D. C.
4—6x8 Fairbanks-Morse, D. C.
3—6x8 M. & S., D. C.
1—6x8 National, S. C.
1—8x10 Fairbanks-Morse, D. C.
1—8x10 Fairbanks-Morse, S. C
1—10x12 Fairbanks-Morse, D. C.
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1—10 hp. Single Drum, Friction
1—15 hp. McFarlane, S. D.
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1—No. 2 Gardner Crusher.
1—No. 1 D Gates Crusher.
1—No. 3 D Gates Crusher.
1—Size "C" Comet Crusher.
2—No. 5 Austin Gyratory Crusher.

ROLLS

1—Set 6x10 Sample Rolls.
1—Set 12x20 McFarlane Rolls.
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1—Set 10x30 Allis-Chalmers Rolls.
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1—Set 16x40 Colo. Iron Works Rolls
1—Set 3x10 Triplex Rolls.
1—Set 5x18 Triplex Rolls.
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1—5x24-ft. Tube Mill.
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1—5x4 Standard Ball Mill.
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The Morse Bros. Machinery & Supply Company

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FOR SALE

5 Dorr Thickeners mechanism with lifting device for 20x10 steel tanks.

3 Dorr Agitators mechanism for steel tanks 12x10 ft., 8 in.

The above have been used three weeks. Immediate shipment.

The Morse Bros. Machinery & Supply Co.
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For Power Plant use in measuring accurately quantity of water fed to boilers, amount of condensation, make-up water, etc. The principle of operation measures by actual volume displacement and is accurate at all rates of flow and water temperatures.

Alberger Pump & Condenser Co.
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The Tirrill "Equalizing" Gas Machine supplies a standard, uniform, non-poisonous gas. Absolutely safe. Used the same as city gas.
Complete gas Plants—$275 up, according to size.
Tirrill High Efficiency Burners insure a gas saving of 25-50%.

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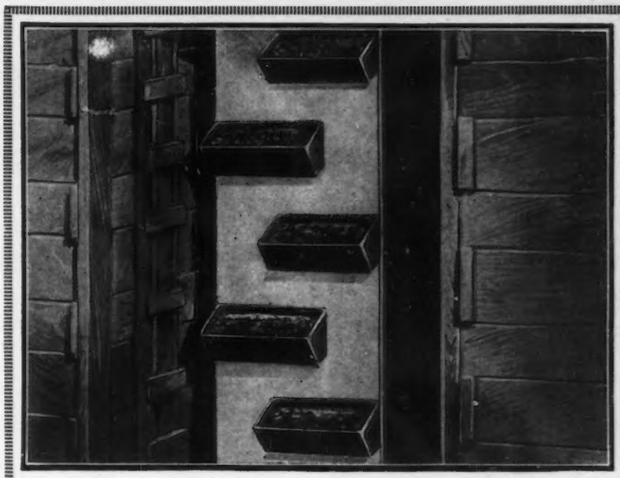

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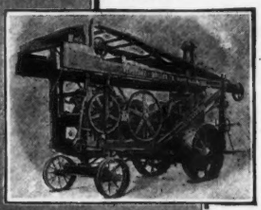

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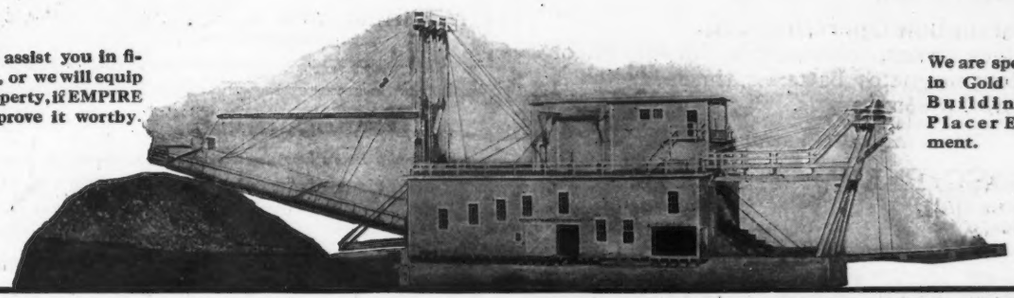

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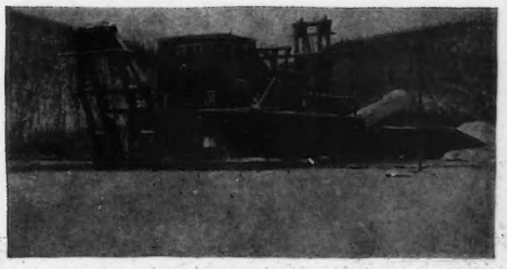

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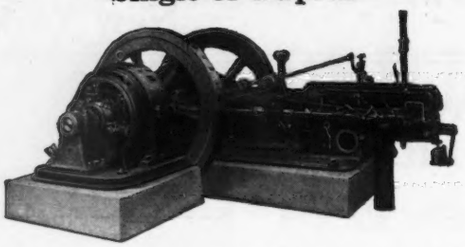

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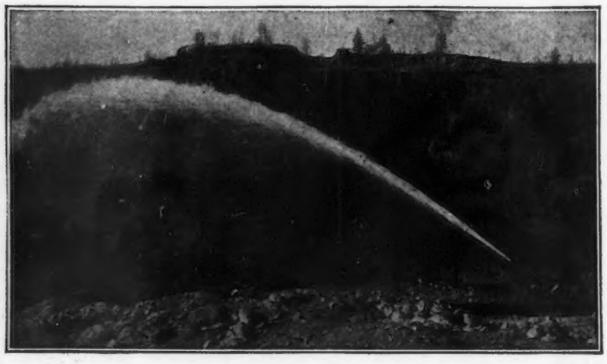

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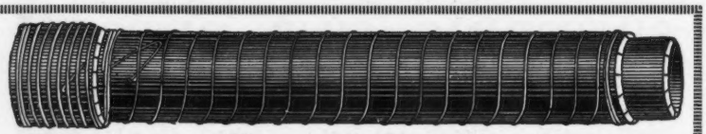

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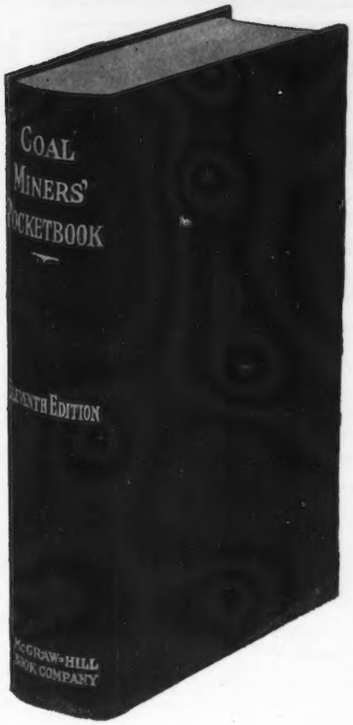

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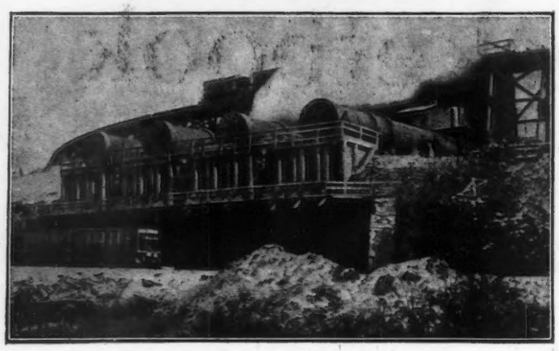

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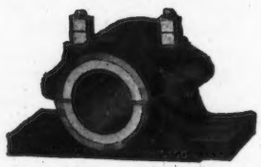

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MacDonald, B., Hellman Bldg., Los Angeles, Cal.
Morse Bros. Mach. & Supply Co., Denver, Colo.
Oliver Continuous Filter Co., San Francisco, Cal.
Filtro automático y continuo para malgamas de cianuro.

Agotadores
Connersville Blower Co., The, Connersville, Ind.
Morse Bros. Mach. & Supply Co., Denver, Colo.

Aguzadores de Barrenos
Hardsocg Wonder Drill Co., Ottumwa, Iowa.
Ingersoll-Rand Co., 11 Broadway, New York.
"Leyner"—Compacto, rápido y simple en operación.
Proske, T. H., Denver, Colo.
"Imperial" consiste en un martinete pequeño vertical de vapor y una máquina horizontal de machacar.
Sullivan Machinery Co., Chicago, Ill., U. S. A.
El aguzador "Sullivan" hace estrías y espigas por medio de un completo martilleo; el acero se sujeta por un tornillo de aire comprimido durante la operación. No se necesitan altas temperaturas. Pídase nuestro boletín No. 272.

Alambre Aislado
Hazard Mfg. Co., Wilkes-Barre, Penn.

Alambre de Cobre
Roebling's Sons Co., John A., Trenton, N. J.

Albayade
Eagle-Picher Lead Co., Cincinnati, Ohio.

Alimentadores de Minerales
Hardinge Conical Mill Co., 120 Broadway, N. Y.
Stephens-Adamson Mfg. Co., Aurora, Ill.
"SA" alimentador batiente de acero; también giratorios de movimiento alternativo, de criba, etc.
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Webster Mfg. Co., Tiffin, Ohio.

Amalgamadores
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Lane Mill Machinery Co., Los Angeles, Calif.
Morse Bros. Mach. & Supply Co., Denver, Colo.
Senn Concentrator Co., 611 First Nat. Bank Bldg., San Francisco, Calif.
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Amianto
Asbestos Protected Metal Co., Pittsburgh, Penn.

Análisis de Minerales
Tibby, Benj. F., 419 Judge Bldg., Salt Lake City, Utah.

Antimonio
Wah Chang Mining & Smelting Co., Woolworth Bldg., New York.

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Este aparato se fabrica en tres tamaños. Las capacidades varían según sea el número de boquereles, mangueras, tamaños y presiones de aire. El "Cement-Gun" es un aparato portátil para depositar capas de cemento o sea "Gunite" por medio de presión de aire para cubrir tanto construcciones viejas como nuevas, llenar las cuarteaduras o grietas que haya, o para ser aplicado al hacer nuevas construcciones.
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Denver Engineering Works Co., Denver, Colo.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.

Aparatos Químicos
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National Tank & Pipe Co., Portland, Ore.

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Troemner, Henry, 911 Arch St., Phila., Penn.

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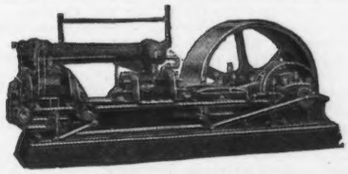

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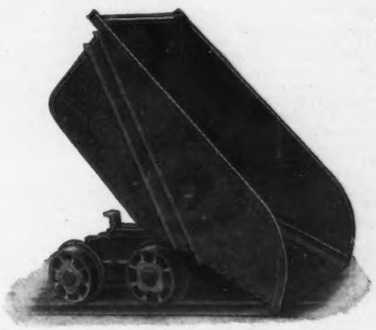

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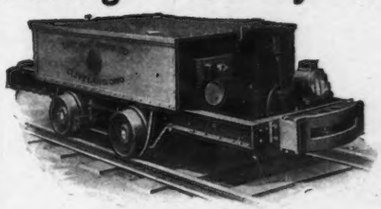

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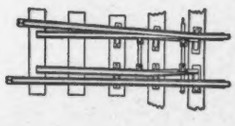

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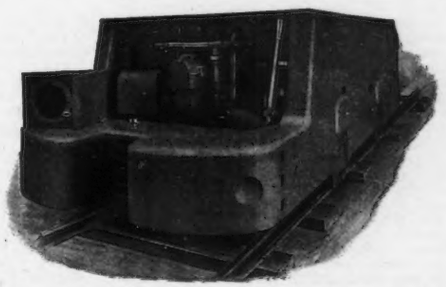

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Hardinge Conical Mill Co., 120 Broadway, New York. Dirección por Cable: "Halharding," N. Y. Sucursal: Lóndres, Salisbury House.
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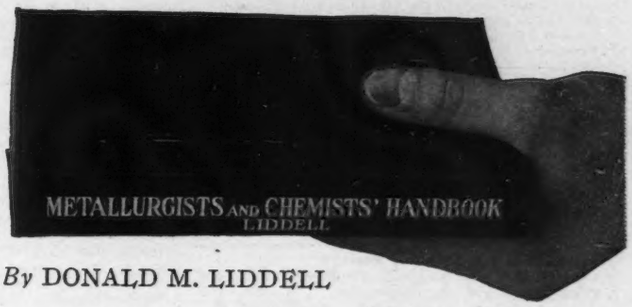

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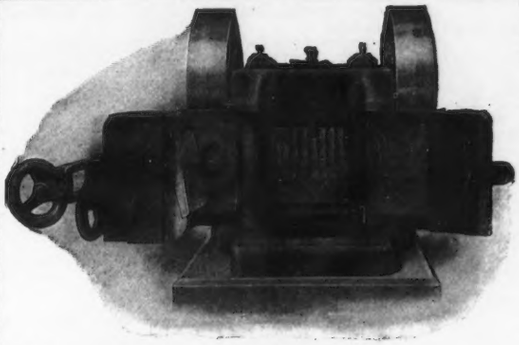

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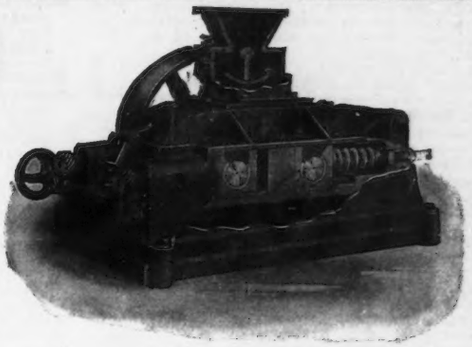

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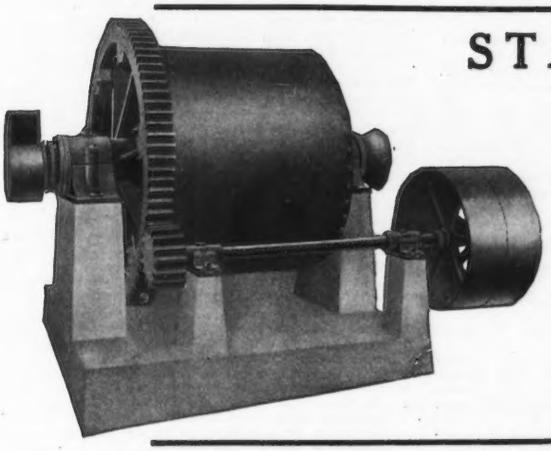

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Hardy, Charles, 50 Church St., New York.
Primos Chemical Co., Primos, Del. Co., Pa. Dirección por Cable: "Briquette, Phila." Sucursales: Vanadium, Lakewood and Empire, Colo.; Dragoon, Ariz.
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Turbinas de Vapor
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De Laval Steam Turbine Co., Trenton, N. J.
Leffel & Co., James, 306 Lagonda St., Springfield, Ohio.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

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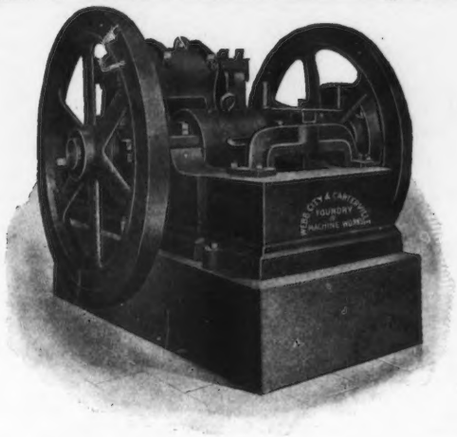

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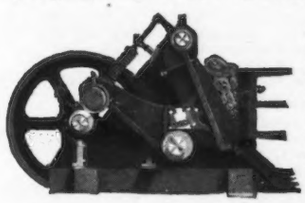

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Hegeler Zinc Co., The, Danville, Ill.
Illinois Zinc Co., Peru, Ill.
Matthiessen & Hegeler Zinc Co., La Salle, Ill.
New Jersey Zinc Co., 55 Wall St., New York.

Acids
Grasselli Chemical Co., The, Cleveland, Ohio.

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Morse Bros. Mach. & Supply Co., Denver, Colo.
Oliver Continuous Filter Co., San Francisco, Cal. Automatic and continuous cyanide slime filter.

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Lane Mill & Machinery Co., Los Angeles, Calif.
Morse Bros. Mach. & Supply Co., Denver, Colo.

Asbestos
Asbestos Protected Metal Co., Pittsburgh, Penn.

Antimony
Wah Chang Mining & Smelting Co., Woolworth Bldg., New York.

Assayers
Baker & Co., Inc., Newark, N. J.
Ledoux & Co., Inc., 99 John St., New York.

Attorneys, Patent
Norris, James L., Norris Bldg., Washington, D. C.

Axles, Locomotive
American Locomotive Co., 30 Church St., N. Y.

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Ainsworth & Sons, Wm., Denver, Colo.
Denver Fire Clay Co., Denver, Colo., U. S. A. Analytical, assay, button balances, made by Keller, Ainsworth, Troemner, Thompson, Otreling, Voland, Becker, Sartorius and Kern.
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Thompson Balance Co., Denver, Colo.
Troemner, Henry, 911 Arch St., Phila., Penn.

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Boston Belting Co., Boston, Mass.
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Goodrich Co., The B. F., Akron, Ohio. All sizes, grades and weights. "Longlife" and "Maxecon" rubber.
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Morse Bros. Mach. & Supply Co., Denver, Colo.

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American Locomotive Co., 30 Church St., N. Y.

Boiler Tubes
National Tube Co., Pittsburgh, Penn.

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Roebling's Sons Co., John A., Trenton, N. J.

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Hendrick Mfg. Co., Carbondale, Penn.
Webster Mfg. Co., Tiffin, Ohio.

Buckets, Ore
Watt Mining Car Wheel Co., Barnesville, Ohio.

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It should contain everything that you use.

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Flory Mfg. Co., S., Bangor, Penn.
Roebling's Sons Co., John A., Trenton, N. J.

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Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Ottumwa Iron Works, Ottumwa, Iowa.

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Diamond Drill Carbon Co., World Bldg., Park Row, New York.
Levine, Abr., 35 Nassau St., New York.

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Easton Car & Construction Co., Easton, Penn.

Cars, Hopper
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Atlas Car & Mfg. Co., Cleveland, Ohio.
Clark Car Co., Pittsburgh, Penn. Western Office: Felt Bldg., Salt Lake City, Utah.
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Roessler & Hasslacher Chemical Co., New York.
Solvay Process Co., Syracuse, N. Y.

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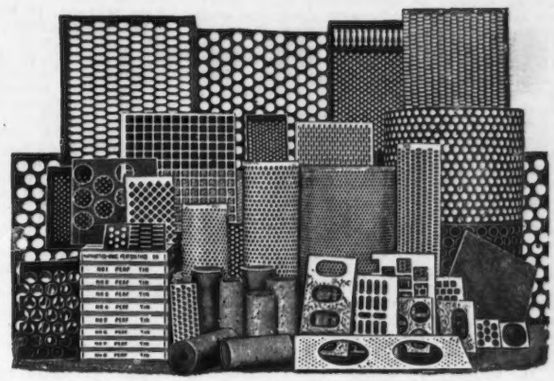

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Pennsylvania Drilling Co., Pittsburgh, Penn.
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Denver Rock Drill Mfg. Co., Denver, Colo.
Electric driven. A self-contained, direct-connected motor and cylinder unit. Includes small electric-driven air compressor and a water tank. Compressor merely supplies air for cleaning hole and to maintain pressure in water tank. Require 3-phase, 60-cycle current. Internal reduction gear transmits power to drill. Screw and shell feed. Hammer strikes 1,200 blows per minute and may be stopped instantly without shutting off electric current.
Hardsocg Wonder Drill Co., Ottumwa, Iowa.
All sizes and weights to 145 lb.
Have combination piston, valve and hammer. For stoping, sinking and all mining purposes.
Ingersoll-Rand Co., 11 Broadway, New York.
"Jackhamers," self-rotating, hammer drill, for every mining operation. Unmounted for down holes, mounted for light drifting, also with Leyner water device. "Leyner-Ingersoll" water drills for drifting, mining, tunneling. "Butterfly" type. "Stopehamers" "BC" and "CC" for raising, stoping, etc.
McKiernan-Terry Drill Co., 230 Bway., New York.
Sullivan Machinery Co., Chicago, Ill., U. S. A.
Whitcomb Co., Geo. D., Rochelle, Ill.

Drills, Piston
Chicago Pneumatic Tool Co., Chicago, Ill.
Cochise Machine Co., Los Angeles, Calif.
Hardsocg Wonder Drill Co., Ottumwa, Iowa.
All sizes and weights.
For use with air or steam.
Ingersoll-Rand Co., 11 Broadway, New York.
"Butterfly," "Sergeant," "Electric Air." All sizes.
Sullivan Machinery Co., Chicago, Ill., U. S. A.
Wood Drill Works, Paterson, N. J.
Nine sizes.

Drills, Prospecting
Ingersoll-Rand Co., 11 Broadway, New York.
New York Eng. Co., 2 Rector St., New York.
Rotation, sinking of casing, recovery of material accomplished at same time with "Empire."
Sullivan Machinery Co., Chicago, Ill., U. S. A.

Dryers, Ore
American Process Co., 68 William St., New York.
Especially designed and built for all materials.
Morse Bros. Mach. & Supply Co., Denver, Colo.
Ruggles-Coles Engineering Co., 50 Church St., New York. Branch: McCormick Bldg., Chicago.

Dust Protectors (See Respirators)

Elbows, Pipe
National Tube Co., Pittsburgh, Penn.

Elevators, Bucket
Stephens-Adamson Mfg. Co., Aurora, Ill.
See advertisement on inside front cover for branch office addresses.
Webster Mfg. Co., Tiffin, Ohio.

Employees
Business Men's Clearing House, Denver, Colo.
Supts., assayers, mill men sent all parts of world.

Engines, Gas and Gasoline
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Chicago Pneumatic Tool Co., Chicago, Ill.
Morse Bros. Mach. & Supply Co., Denver, Colo.

Engines, Oil
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Chicago Pneumatic Tool Co., Chicago, Ill.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Ingersoll-Rand Co., 11 Broadway, New York.
Morse Bros. Mach. & Supply Co., Denver, Colo.
National Transit Pump & Mach. Co., Oil City, Pa.
Nordberg Mfg. Co., Milwaukee, Wis.

Engines, Steam
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Morse Bros. Mach. & Supply Co., Denver, Colo.
Morris Mach. Wks., Baldwinsville, N. Y. Branch: 39-41 Cortland St., New York, U. S. A.

Exhausters
Connersville Blower Co., The, Connersville, Ind.
Morse Bros. Mach. & Supply Co., Denver, Colo.

Feeders, Ore
Stephens-Adamson Mfg. Co., Aurora, Ill.
"S-A" steel apron feeder; also rotary, reciprocating, grizzly, etc.
See inside cover for branch office addresses.
Webster Mfg. Co., Tiffin, Ohio.

Filter Cloth, Metallic
Sweetland Filter Press Co., Brooklyn, N. Y.

Filter Paper
Heil Chemical Co., Henry, St. Louis, Mo.

Filters
Colorado Iron Works Co., Denver, Colo.
"Portland" continuous revolving drum. For cyanide slimes, flotation concentrates, etc.
Kelly Filter Press Co., Salt Lake City, Utah.
Oliver Continuous Filter Co., San Francisco, Cal.
Sizes 5 to 200 tons per day.
Automatic. For cyanide slimes, clay, salt, bicarbonate soda, and for dewatering flotation concentrate.
Sweetland Filter Press Co., Brooklyn, N. Y.
Pressure leaf type. Convenient to operate.

Fire Forcing Presses
Wood & Co., R. D., Philadelphia, Penn.

Fireproof Roofing
Asbestos Protected Metal Co., Pittsburgh, Penn...

Flange Presses
Wood & Co., R. D., Philadelphia, Penn.

Flanges, Pipe
National Tube Co., Pittsburgh, Penn.

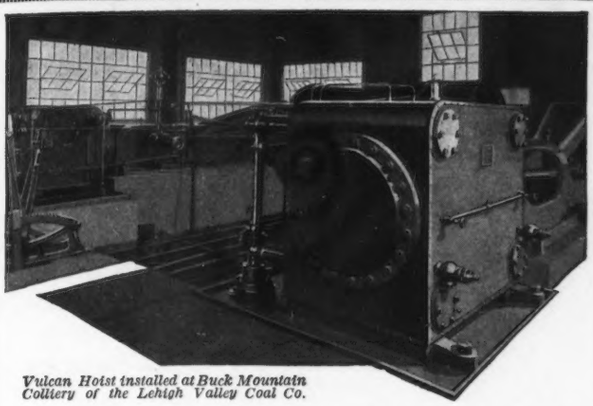
Flotation Cell Bottoms, Cloth
Filter Fabrics Co., Salt Lake City, Utah.

Flotation Oils
General Naval Stores Co., 175 Front St., N. Y.
Georgia Pine Turpentine Co., 160 Perry St., New York City.
Pensacola Tar & Turpentine So., Gulf Point, Fla.
Spirittine Chemical Co., Wilmington, N. C.

Flotation, Oil
Colorado Iron Works Co., Denver, Colo.
Portland filter for dewatering concentrates.
Minerals Separation American Syndicate (1913), Ltd.—Sole Agents: Beer, Sondheimer & Co., 61 Broadway, New York. Chief Engineer, E. H. Nutter, Merchants' Exchange Bldg., San Francisco.
Separates sulphide minerals from gangue.
Oliver Continuous Filter Co., San Francisco, Cal.
Dewaterer and dryer of flotation concentrate.

Forges
Denver Fire Clay Co., Denver, Colo., U. S. A.
Oil-fired for drill steel. Send for catalog.
Ingersoll-Rand Co., 11 Broadway, New York.
Monarch Eng. & Mfg. Co., Baltimore, Md.
Proske, T. H., Denver, Colo.

Framers, Timber
Denver Engineering Works Co., Denver, Colo.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.



Vulcan Hoist installed at Buck Mountain Colliery of the Lehigh Valley Coal Co.

EVERY VULCAN Hoist was designed to fit some condition or set of conditions.

The stock designs—there is a considerable number—meet average mining conditions perfectly. They are the outgrowth of years of investigating and designing.

Where investigation shows conditions to require special treatment—conditions which a stock hoist could not meet *most economically*—it is Vulcan practice to design a special hoist.

In both steam and electric hoists the soundness of this Vulcan policy has been amply demonstrated by the unqualified success of the hundreds of Vulcan installations.

An analysis of your property by Vulcan engineers will indicate the type of hoist best suited for it. No obligation.

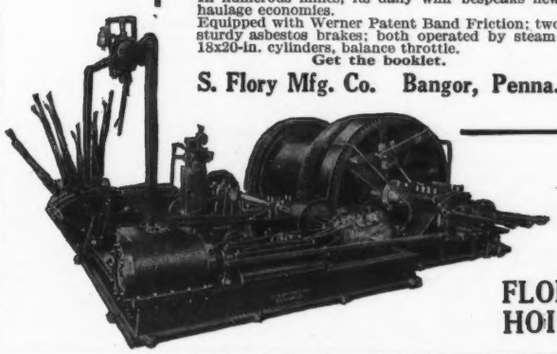
Vulcan Iron Works
1733 Main Street, Wilkes-Barre, Pa.
New York Chicago

Vulcan Hoists

This Hoist Talks For Itself

In numerous mines, its daily whir bespeaks new haulage economies.
Equipped with Werner Patent Band Friction; two sturdy asbestos brakes; both operated by steam; 18x20-in. cylinders, balance throttle.
Get the booklet.

S. Flory Mfg. Co. Bangor, Penna.



FLORY HOIST

Wuest Herringbone Gears

Make 20 to 1 Reductions Possible

Herringbone Construction and the Wuest Patent make wonderful single reductions possible. Let us tell you all about it in our descriptive matter.

Write

The Falk Company, Milwaukee, Wisconsin

Harbison-Walker Refractories Company

MANUFACTURERS OF
High Grade Silica, Chrome, Magnesia and Fire Clay Brick.
IMPORTERS OF
Chrome Ore and Spaeter Dead-Burned Magnesite.

PITTSBURGH, PA.

Three times as far away from the scrap heap

It isn't 'til a shovel goes to the scrap heap that you can figure how much its cost was.

First cost—well, you know as well as we do, that first cost as a standard of real cost is a back number.

Do Wyoming-Mayari Red Edge Shovels cost more at first? Yes. We answer "Guilty!" to that question cheerfully.

But in final cost, real cost, their price is very low—because while one Wyoming-Mayari Shovel is wearing out, three ordinary shovels have started work, bloomed and withered.

And it isn't only the shovel economy that counts—it's the shoveling economy—the fact that your men are using three times as long a shovel with a full blade and an unbroken edge. That's the real reason for using Wyoming-Mayari Shovels.

We repeat: Chrome Nickel Steel Blades, Heat-Treated, make these shovels worth much more than you pay for them.

Our Catalog will give you the complete facts. Write for a copy.

The Wyoming Shovel Works

Wyoming, Pa.

WYOMING-MAYARI RED EDGE SHOVELS

Frogs and Switches
Cincinnati Frog & Switch Co., Cincinnati, Ohio.

Furnaces, Assay
Braun Corporation, The, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Calif.
Denver Fire Clay Co., Denver, Colo., U. S. A.
"Case" patent. One-, two- or three-muffle design unit system, low-pressure air.

Furnaces, Bullion Melting
Braun Corporation, The, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Denver Fire Clay Co., Denver, Colo., U. S. A.
"Case" patent. Oil-fired, low-pressure air, high temperatures quickly attained.
Send for catalog.
Monarch Engineering & Mfg. Co., Baltimore, Md.

Furnaces, Mechanical Roasting
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Dwight & Lloyd Sintering Co., Inc., N. Y. City.
General Chemical Co., Herreshoff Furnace Dept. B, 25 Broad St., New York, N. Y.
Cylindrical steel shell contains vertically superimposed hearths. By rabble arms operated from central vertical shaft, roasting ore travels from center of top hearth, down through lower ones, discharging from rim of lowest. Heated air for combustion travels upward.
Morse Bros. Mach. & Supply Co., Denver, Colo.
Wedge Mechanical Furnace Co., 115 Chestnut St., Philadelphia.
Varying stock sizes, number of hearths and hearth areas.
Hearths placed one above the other vertically, all enclosed in suitable shell. Vertical shaft revolves in center, raking ore on hearths, by rabbles and teeth attached to arms Ore travels through furnace from top to bottom. To correct inequalities in the supply of heat, combustion gases pass through heating chambers between hearths, as well as to hearths themselves. External fireboxes communicate with the heating chambers through flues. Central shaft designed to be accessible.
Zinc Concentrating Co., The, 60 Congress St., Boston, Mass.
Etherington-Singer roaster used in connection with Campbell magnetic separating process. Non-oxidizing. Oil fuel. Roasts in comparatively short time.

Furnaces, Smelting
Colorado Iron Works Co., Denver, Colo.
Morse Bros. Mach. & Supply Co., Denver, Colo.
Traylor Eng. & Mfg. Co., Allentown, Penn.

Fuses, Electric
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Gas Burner Appliances
Tirrill Gas Machine Lighting Co., New York City.

Gas Making Machines
Tirrill Gas Machine Lighting Co., New York City.

Gas Producers
Wellman-Seaver-Morgan Co., Cleveland, Ohio.
Wood & Co., R. D., Philadelphia, Penn.

Gas Purifiers
Wood & Co., R. D., Philadelphia, Penn.

Gears
Philadelphia Gear Works, 1120 Vine St., Philadelphia. Cable Address: "Philagear."
All sizes.
All descriptions gear cutting and wheels.

Gears, Bevel
Philadelphia Gear Works, 1120 Vine St., Philadelphia. Cable Address: "Philagear."
Webster Mfg. Co., Tiffin, Ohio.

Gears, Double Helical
Caldwell & Sons Co., H. W., 17th St. and Webster Ave., Chicago.
Falk Co., The, Milwaukee, Wis.
Any face to 42"; diameter to 12 ft.
Staggered herringbone teeth with continuous tooth engagement. Machine-cut from solid blanks.

Gears, Rawhide
Philadelphia Gear Works, 1120 Vine St., Philadelphia. Cable Address: "Philagear."

Generators, Electric
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Joseph, Jersey City, N. J.

Grease
Dixon Crucible Co., Joseph, Jersey City, N. J.

Grease Cups
Lunkenheimer Co., The, Cincinnati, O., U. S. A.

Grinders, Ore
Braun Corporation, The, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Laboratory machines for ore, coke and coal.
Sturtevant Mill Co., Boston, Mass.

Grinders, Sample
Denver Engineering Works Co., Denver, Colo.
Sturtevant Mill Co., Boston, Mass.

Head Frames, Mine
American Bridge Co., 30 Church St., New York.

Hoists, Electric
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Denver Engineering Works Co., Denver, Colo.
English Iron Works, Kansas City, Mo.
Flory Mfg. Co., S., Bangor, Penn.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Lidgerwood Mfg. Co., 96 Liberty St., New York.
Branches: Philadelphia, Pittsburgh, Chicago, Seattle.
All sizes.
Nordberg Mfg. Co., Milwaukee, Wis.
Ottumwa Iron Works, Ottumwa, Iowa.
Sizes 15 to 50 hp. in stock.
Vulcan Iron Works, Wilkes-Barre, Penn.
Wellman-Seaver-Morgan Co., The, Cleveland, O.
Branches: New York and Denver, Colo.
Any size or capacity. Designed for any job. First or second motion.

Hoists, Portable
Chicago Pneumatic Tool Co., Chicago, Ill.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Ingersoll-Rand Co., 11 Broadway, New York.
"Little Tugger"—for drill column, bar or timber mounting.

Hoist Recorder
Johnson, J. M. & O. R., Ishpeming, Mich.
Records automatically and graphically on chart in engine room, position of cage or skip at any minute of day.

THIS is a **live** list of reputable concerns that sell machinery and supplies for metal mines, mills and smelters. Its use will save your time.

Hoists, Steam
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
English Iron Works, Kansas City, Mo.
Lidgerwood Mfg. Co., 96 Liberty St., New York.
Sizes up to 1,000 hp.
Nordberg Mfg. Co., Milwaukee, Wis.
Ottumwa Iron Works, Ottumwa, Iowa.
Sullivan Machinery Co., Chicago, Ill., U. S. A.
First motion Corliss and geared slide valve with automatic cut-off.
Vulcan Iron Works, Wilkes-Barre, Penn.
Wellman-Seaver-Morgan Co., The, Cleveland, O.

Hose, Air
Cleveland Rock Drill Co., Cleveland, Ohio.
All sizes.
Plain and wire wound in stock.
Goodrich Co., The B. F., Akron, Ohio.
Sizes ½-in. up.
Constructed with canvas on outside for protection against cuts. Three grades.
Hardsocg Wonder Drill Co., Ottumwa, Iowa.
½", ¾", 1", plain and armored. Fitted with nipples and patent coupler.
Quaker City Rubber Co., 629 Market St., Phila., Pa.

Houses, Steel Shaft
American Bridge Co., 30 Church St., New York.

Hydraulic Accumulators
Wood & Co., R. D., Philadelphia, Penn.

Hydraulic Giants
Pelton Water Wheel Co., San Francisco. New York.

Instruments, Surveying
Ainsworth & Sons, Wm., Denver, Colo.
Berger & Sons, C. L., Boston, Mass.
Buff & Buff Mfg. Co., Boston, Mass.
Transits, levels, current meters.

Idlers, Conveyor
Conveying Weigher Co., The, New York City.

Insulating Materials, Electric
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Iron and Steel
Asbestos Protected Metal Co., Pittsburgh, Penn.
Asbestos protected, corrugated plates and shapes.

Jackets, Water
Traylor Eng. & Mfg. Co., Allentown, Penn.

Jigs
American Zinc Ore Separating Co., 1218 Foster Bldg., Denver, Colo.
Two sizes, 24 and 36 in. Capacities to 15 tons per 24 hr.
Operates with air instead of water. Air, through a rotary valve delivers rapid succession of air impulses beneath screen, stratifying concentrates on screen. Feed and discharge automatic.
Denver Engineering Works Co., Denver, Colo.
Richards pulsator jigs and riffles.

Laboratory Machinery
Braun Corporation, The, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Denver Fire Clay Co., Denver, Colo.
Elmer & Amend, 205 Third Ave., New York.
Sturtevant Mill Co., Boston, Mass.

Laboratory Supplies
Heil Chemical Co., Henry, St. Louis, Mo.

Lamps, Acetylene
Milburn Co., The Alexander, Baltimore, Md.
Simmons Co., John, 34 35th St., Brooklyn, N. Y.
From 3- to 12-hr. capacity.
Baldwin and Zar. Cap and hand styles.
Wolf Safety Lamp Co., 74 Washington St., N. Y.

Lamps, Electric
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Lightning Arresters
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Line Material, Overhead
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Locomotives, Compressed Air
Porter Co., H. K., 410 Wood St., Pittsburgh, Pa.

Locomotives, Electric
Jeffrey Mfg. Co., The, 974 N. 4th St., Columbus, O.
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Locomotives, Electric, Storage Battery
Atlas Car & Mfg. Co., Cleveland, Ohio.
Jeffrey Mfg. Co., The, 974 N. 4th St., Columbus, O.
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Locomotives, Gasoline
Vulcan Iron Works, Wilkes-Barre, Penn.
Whitcomb Co., Geo. D., Rochelle, Ill.

Locomotives, Industrial
American Locomotive Co., 30 Church St., N. Y.

Locomotives, Mine
American Locomotive Co., 30 Church St., N. Y.

Locomotive Parts
American Locomotive Co., 30 Church St., N. Y.

Locomotives, Steam
American Locomotive Co., 30 Church St., N. Y.
Porter Co., H. K., 410 Wood St., Pittsburgh, Pa.
Branch: 30 Church St., New York.
Vulcan Iron Works, Wilkes-Barre, Penn.

Lubricants
Dixon Crucible Co., Joseph, Jersey City, N. J.

Lubricators
Whitcomb Co., Geo. D., Rochelle, Ill.

Metals, Noncorrosive
International Nickel Co., The, 43 Exchange Place, New York.
"Monel" metal. Tough acid-resisting alloy. Rods, flats, castings, sheets, strips and wire.

Metals, Perforated
Erdle Perforating Co., Rochester, N. Y.
Harrington & King Perforating Co., The, 620 N. Union Ave., Chicago, Ill. Branch: 114 Liberty St., New York.
All sizes and shapes of perforations; all kinds and thicknesses of metals.
Screens for trommels, stamp mills, jigs, etc.
Hendrick Mfg. Co., Carbondale, Penn.

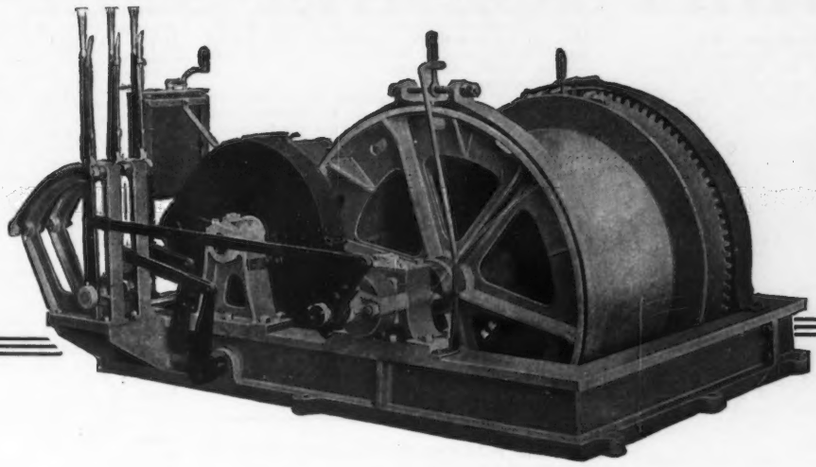
Meters, Electric Current
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Mills, Ball, Tube and Pebble
Colorado Iron Works Co., Denver, Colo.
Denver Engineering Works Co., Denver, Colo.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Traylor Eng. & Mfg. Co., Allentown, Penn.
All sizes and capacities.
Williamson, F. O., Old Colony Bldg., Chicago, Ill.

Mills, Chilean
Lane Mill & Machinery Co., Los Angeles, Calif.
Cable: "Lanemill."

Lidgerwood Mine Hoists

STEAM
BUILT UP TO 1,000 HP.



ELECTRIC
BUILT IN ANY SIZE

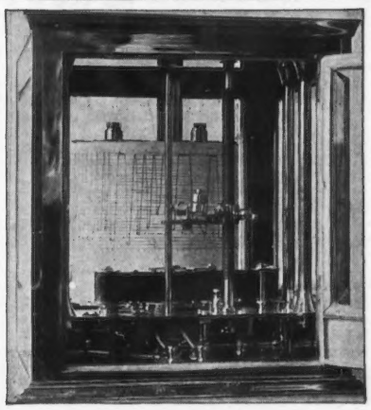
Safety of your men and the daily operation of your mine depends upon your hoist. A cheaply built hoist is very expensive. Our hoists embody every element required for safety, durability and capacity.

More than 38,000 Steam and Electric Hoists built and used

Send for catalogs describing our products

LIDGERWOOD MFG. CO., 96 Liberty St., NEW YORK

Philadelphia Pittsburgh Chicago Seattle London, Eng.



How long was the skip stopped?

When the cash is all counted, the men's time checked, what about your machine record? How many hours were lost because the skip was tied up on one level while the men on another level were loafing around waiting for it to come along?

What sort of an engineer have you? Does he keep things "on the jump" or is he one of the slow and sleepy kind?

You can tell all these things by a glance at the 12-hour record chart of the

Johnson Hoist Recorder

If you are interested write us for full description.

J. M. & O. R. Johnson, Ishpeming, Michigan

angry because of Gears?

Ask us questions about Material workmanship delivery and Prices- Do It Today

PHILADELPHIA GEAR WORKS

Geo. B. Grant, M. E.

Vine and 12th Streets Philadelphia

Sizes: 5-, 7- and 10-ft. Cap.: 10, 20 and 40 tons per 24 hr.
"Slow-speed" Chilean mills. 20- and 40-ton mills can be sectionalized for transportation on pack animals.
Wellman-Seaver-Morgan Co., The, Cleveland, O. "Akron." Three sizes from 10 to 160 tons per 24 hr.

Mills, Stamp
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Denver Engineering Works Co., Denver, Colo.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Hendy Iron Works, Joshua, San Francisco, Calif.
Traylor Eng. & Mfg. Co., Allentown, Penn.

Minerals and Ores, Rare
Foote Mineral Co., 107 N. 19th St., Phila., Pa.
Specialists in unusual ores.

Mixers, Concrete
Smith Co., The T. L., 1143 32nd St., Milwaukee.
Hand batch mixer for mines, $120. Power mixers, all sizes, any equipment.

Molybdenum
Primos Chemical Co., Primos, Del. Co., Pa. Cable: "Briquette, Phila." Branches: Vanadium, Lakewood and Empire, Colo.; Dragoon, Ariz. Agents: Allen S. Davison & Co., Pittsburgh, Pa.

Motor Control
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.
For all types and capacities of motors.

Motor Trucks
Whittall, G. G., Orono, Calif.

Motor Generator-Sets
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Motor Trailers
Whittall, G. G., Orono, Calif.

Motors
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Netting, Wire
Ludlow-Saylor Wire Co., St. Louis, Mo.
"Hex" poultry netting. Stack netting for locomotives.
Catalog No. 45.

Nickel
International Nickel Co., The, 43 Exchange Place, New York.

Oiled Clothing
Goodrich Co., The B. F., Akron, Ohio.
So'westers, jackets, apron pants. Rubber goods for abrasive wear.

Oils, Flotation (See "Flotation Oils")

Ore Analyses
Tibby, Benj. F., 419 Judge Bldg., Salt Lake City, Utah.

Ore, Buyers and Sellers of
American Metal Co., New York City.
Agents: Henry R. Merton & Co., Ltd., London; Metallgesellschaft, Frankfort-on-the-Main; Compania des Minerales y Metales, Mexico City and Monterey; Ore Trading Co., Ltd., Santiago, Chile.
American Smelting & Refining Co., 120 Broadway, New York.
Agents: Paul Koning, Berlin, Germany; Kleinwort, Sons & Co., London, England; W. A. Price and Geo. J. Ewart, City of Mexico; F. D. Aller, Antofasgasta, Chile.
American Zinc, Lead & Smelting Co., 55 Congress St., Boston, Mass.
American Zinc & Chemical Co., Langeloth, Penn.
Balbach Smelting & Refining Co., Newark, N. J.
Bartlesville Zinc Co., 52 Broadway, New York.
Beer, Sondheimer & Co., 61 Broadway, New York. Branch: 1101 Newhouse Bldg., Salt Lake City, Utah.
See advertisement.
Blackwell, Sons & Co., Ltd., Geo. G., The Albany, Liverpool, England.
Consolidated Mining & Smelting Co. of Canada, Ltd., The, Trail, British Columbia.
Ducktown Sulphur, Copper & Iron Co., Ltd., Isabella, Tenn.
Edgar Zinc Co., Boatmen's Bank Bldg., St. Louis, Mo. Western Ore Purchasing Agent: David Taylor, Boston Bldg., Salt Lake City, Utah.
Foote Mineral Co., 107 N. 19th St., Philadelphia, Penn.
Granby Mining & Smelting Co., Suite 1710, Third National Bank Bldg., St. Louis, Mo. 165 Broadway, New York, N. Y.
Grasselli Chemical Co., The, Cleveland, Ohio.
Hardy, Charles, 50 Church St., New York.
Hegeler Zinc Co., The, Danville, Ill.
Illinois Zinc Co., Peru, Ill.
International Smelting Co., 42 Broadway, New York. Ore Purchasing Department, 621 Kearns Bldg., Salt Lake City, Utah. Smelting Works, International, Utah, and Miami, Ariz. Refiner-International Lead Refining Co., E. Chicago, Ind. Irvington Smelting & Refining Works, Irvington, N. J. Branch Office: New York.
Matthiessen & Hegeler Zinc Co., La Salle, Ill.
Nichols Copper Co., 25 Broad St., New York.
See advertisement.
Pass & Son, Ltd., Capper, Bristol, England.
Pennsylvania Smelting Co., Pittsburgh, Penn.
Phelps, Dodge & Co., New York City.
Philipp Bros., 29 Broadway, New York.
Primos Chemical Co., Primos, Del. Co., Pa. Cable: "Briquette, Phila." Branches: Vanadium, Lakewood and Empire, Colo.; Dragoon, Ariz. Agents: Allen S. Davison & Co., Pittsburgh.
St. Joseph Lead Co., 61 Broadway, New York.
United Metals Selling Co., 42 Broadway, New York. European Agents: C. S. Henry & Co., Ltd., 12 Leadenhall St., London, E. C.; United Metals Selling Co., G. M. B. H., Unter den Linden 56, Berlin, Germany.
See advertisement.
United States Smelting, Refining & Mining Co., 55 Congress St., Boston, U. S. A. Works: Midvale, Utah; Needles, Calif.; Gold Road, Ariz.; Kennett, Calif.; Chrome, N. J.; Grasselli, Ind.; Pachuca and Real del Monte, Mexico.
See advertisement.
Vogelstein & Co., L., 42 Broadway, New York. European Agents: Aron Hirsch & Sohn, Halberstadt, Germany.
Wallower Refining & Reduction Works, Webb City, Mo.

Ores, Samplers of
Beach & Co., 204 Boston Bldg., Denver, Colo.
Supervise weighing and sampling at smelters.
Ledoux & Co., Inc., 99 John St., New York.

Packing
Goodrich Co., The B. F., Akron, Ohio.
Sheet, tubular, spiral, square. Rubber and duck
Jenkins Bros., 80 White St., New York.

Packing, Sheet
Quaker City Rubber Co., 629 Market St., Phila., Pa.

Paint, Preservative
Dixon Crucible Co., Joseph, Jersey City, N. J.

Packing, Rod
Quaker City Rubber Co., 629 Market St., Phila., Pa.

Pebbles, Grinding
Atkins, Kroll & Co., San Francisco.

Pipe, Cast Iron
Wood & Co., R. D., Philadelphia, Penn.
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United Lined Tube & Valve Co., 180 Franklin St., Lead-lined pipe for acidiferous and corrosive waters.

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American Spiral Pipe Works, Chicago, Ill.
To 40 in. diameter and 40 ft. long.
Weigele Riveted Steel Pipe Works, Denver, Colo.

Pipe, Spiral Riveted
Abendroth & Root Mfg. Co., 45 Bway., New York.

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National Tube Co., Pittsburgh, Penn.

Pipe, Wood
National Tank & Pipe Co., Portland, Oregon.
Pacific Tank & Pipe Co., San Francisco, Calif.
Redwood Mfrs. Co., San Francisco, Calif.
Washington Pipe & Foundry Co., Tacoma, Wash.
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Wyckoff & Son Co., A., Elmira, N. Y.

Platinum
Baker & Co., Inc., Newark, N. J. Branch: New York.
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Bishop & Co. Platinum Works, J., Malvern, Penn.

Preservative, Metal
Highland Chemical Products Co., Connellsville, Penn.

Presses, Filter
Kelly Filter Press Co., Salt Lake City, Utah.
Shriver & Co., T., 826 Hamilton St., Harrison, N. J.
Sweetland Filter Press Co., Brooklyn, N. Y.

Presses, Hydraulic
Wood & Co., R. D., Philadelphia, Penn.

Publishers, Technical Book
McGraw-Hill Book Co., Inc., 239 W. 39th St., New York. Branches: London and Berlin.

Pulverizers, Ore
Braun Corporation, The, Los Angeles, Calif.
Laboratory machines for all purposes and prospecting.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Sturtevant Mill Co., Boston, Mass.

Pump Controllers
Laidlaw-Dunn-Gordon Plant, 115 Broadway, N. Y.

Pumping Engines
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Prescott Steam Pump Co., Fred M., New York.

Pumps, Boiler Feed
Deming Co., The, Salem, Ohio.

Pumps, Centrifugal
Byron Jackson Iron Works, Inc., San Francisco.
De Laval Steam Turbine Co., Trenton, N. J.
Deming Co., The, Salem, Ohio.
Krogh Pump Mfg. Co., San Francisco, Calif.
Pelton Water Wheel Co., San Francisco, New York.
Wood & Co., R. D., Philadelphia, Penn.

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Alberger Pump & Condenser Co., New York City.
Byron Jackson Iron Works, Inc., San Francisco.
Cameron Pump Works, 11 Bway., New York.
Sheet, rod, wick, rope and stem packing.
Deming Co., The, Salem, Ohio.
Krogh Pump Mfg. Co., San Francisco, Calif.
Morris Mach. Wks., Baldwinsville, N. Y. Branch: 39-41 Cortland St., New York, U. S. A.

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Byron Jackson Iron Works, Inc., San Francisco.
Deming Co., The, Salem, Ohio.
Krogh Pump Mfg. Co., San Francisco, Calif.

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Cameron Pump Works, 11 Bway., New York.
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Krogh Pump Mfg. Co., San Francisco, Calif.
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Roots Co., P. H. & F. M., Connersville, Ind.
Wood & Co., R. D., Philadelphia, Penn.

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Deming Co., The, Salem, Ohio.
Frenier & Son, J. H., Rutland, Vt., U. S. A.
Laidlaw-Dunn-Gordon Plant, 115 Bway., N. Y.
Morris Mach. Wks., Baldwinsville, N. Y. Branch: 39-41 Cortlandt St., New York, U. S. A.
Krogh Pump Mfg. Co., San Francisco, Calif.
Roots Co., P. H. & F. M., Connersville, Ind.
Traylor Eng. & Mfg. Co., Allentown, Penn.

Pumps, Oil
Laidlaw-Dunn-Gordon Plant, 115 Bway., N. Y.

Pumps, Pneumatic Air Lift
Sullivan Machinery Co., Chicago, Ill., U. S. A.

Pumps, Power Plant
Alberger Pump & Condenser Co., New York.
Cameron Pump Works, 11 Bway., New York.
Deming Co., The, Salem, Ohio.
Laidlaw-Dunn-Gordon Plant, 115 Bway., N. Y.
Morris Machine Works, Baldwinsville, N. Y. Branch: 39-41 Cortlandt St., New York, U. S. A.
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Alberger Pump & Condenser Co., New York.

Pumps, Vacuum
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Ingersoll-Rand Co., 11 Broadway, New York.
Roots Co., P. H. & F. M., Connersville, Ind.

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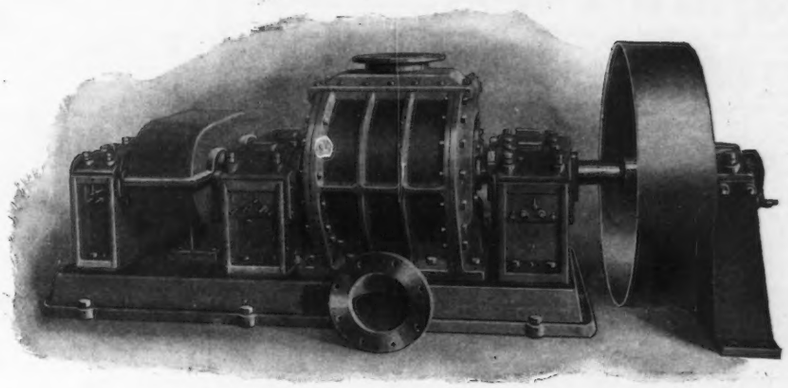

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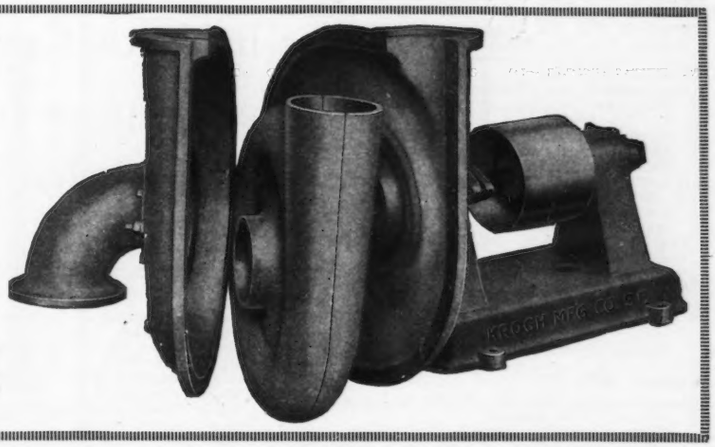

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Roebling's Sons Co., John A., Trenton, N. J.
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Morse Bros. Machine & Supply Co., Denver, Colo.
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All styles of points.
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Mutual Smelting & Refining Co., The, Columbus, O.
United States Smelting, Refining & Mining Co., 55 Congress St., Boston, U. S. A.
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Wyoming Shovel Works, Wyoming, Penn.

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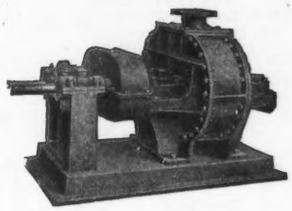

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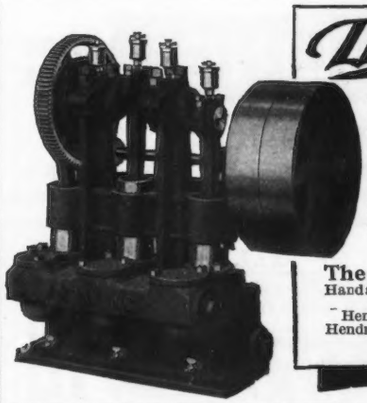

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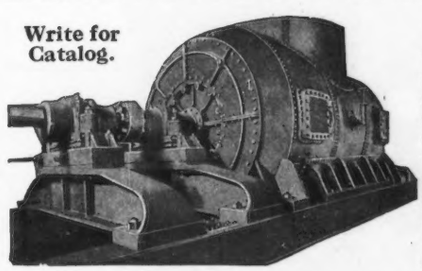

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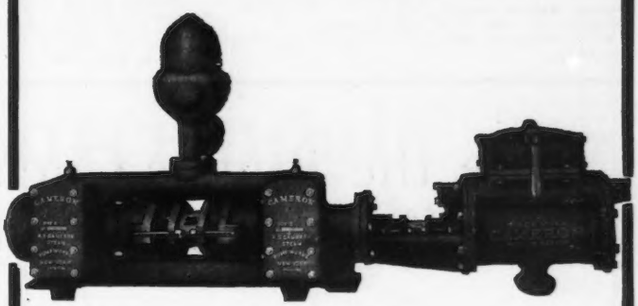

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All meshes and gauges. Steel, brass, copper and bronze, galvanized hardware cloth and window screen cloth.
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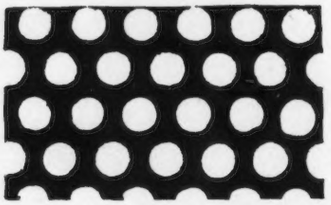

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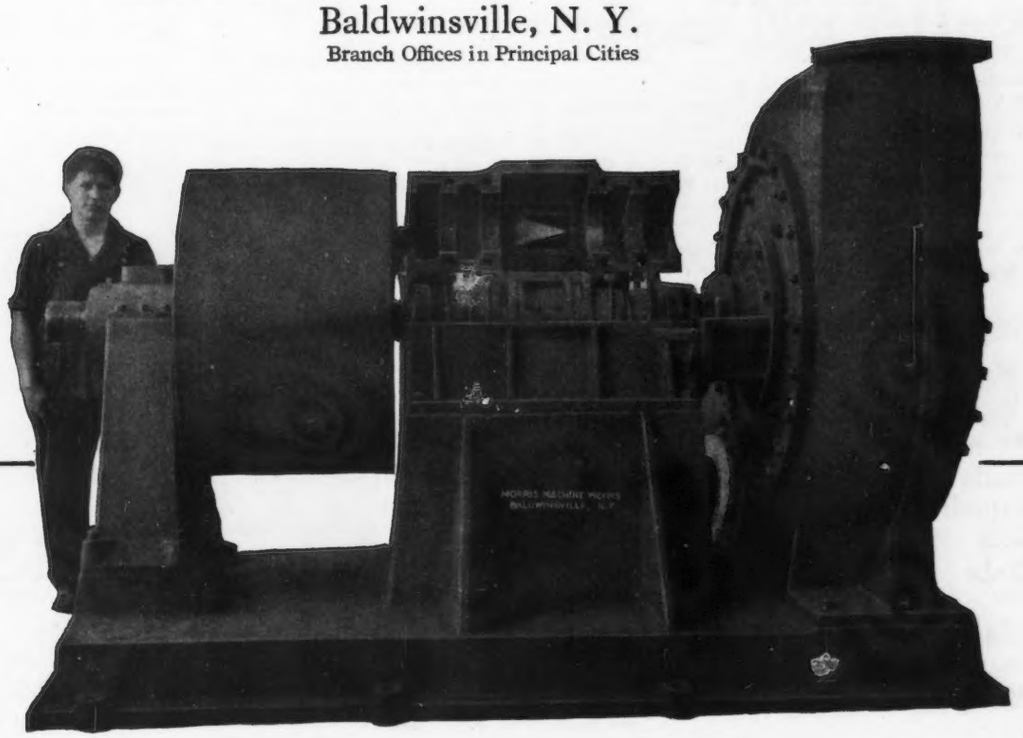

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